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## Announcement of The Graduate School 1921-1922

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# CALENDAR

1921-1922

## FIRST TERM

Sept. 21-22, 1921.	Registration of new students.
Sept. 23, 1921.	Registration of old students.
Sept. 26, 1921.	Instruction begins.
Dec. 15, 1921.	Last day for announcing titles of theses by candidates for advanced degrees in June.
Feb. 8, 1921.	Last day for completing requirements for advanced degrees to be conferred in February.

## SECOND TERM

Feb. 10-11, 1922.	Registration for second term.
March 15, 1922.	Last day for filing applications for fellowships and graduate scholarships.
June 17, 1922.	Last day for completing requirements for advanced degrees to be conferred at Commencement.
June 21, 1922.	Commencement.

## INDEX

The abbreviations in parenthesis indicate the colleges to whose special announcements prospective graduate students are referred for more detailed information concerning advanced work in the various subjects. See page 19. A. & S. = College of Arts and Sciences; Agr. = College of Agriculture; Arch. = College of Architecture; C.E. = College of Civil Engineering; M.E. = Sibley College of Mechanical Engineering; Med. = Medical College; N. Y. Med. = Medical College in New York City; Vet. = Veterinary College; Chem. = Department of Chemistry.

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# **THE GRADUATE SCHOOL**

## **ADMISSION**

The Graduate School has exclusive control of all graduate work carried on in the University. Graduates of the following colleges of Cornell University, namely, the College of Arts and Sciences, the College of Architecture, the College of Civil Engineering, the Sibley College of Mechanical Engineering, the New York State College of Agriculture, and the New York State Veterinary College, and also graduates of other institutions in which the requirements for the first degree are substantially equivalent, are eligible for admission to the Graduate School. In other cases studies pursued after graduation, and experience gained by professional work or otherwise, are taken into consideration in deciding whether the candidate's preparation as a whole is such as to justify his admission to the Graduate School. Graduates of colleges other than those of Cornell University may be admitted to the Graduate School, but not to candidacy for an advanced degree, if their training is regarded as less than one year short of that required for the first degree at Cornell University.

In order to be admitted to the Graduate School, a student must furnish evidence that he has already received a first degree, by presenting either a diploma or a statement from some official source. The simplest procedure will ordinarily be to submit an official statement from the registrar or dean that the degree has been conferred. In the case of graduates of Cornell University this is not necessary, since the records are conveniently accessible.

To avoid delays at the beginning of the academic year, those who desire to enter the Graduate School are advised to make application for admission, either in person or by letter, in the preceding spring or summer. Correspondence should be addressed to the Dean of the Graduate School, Cornell University, Ithaca, New York.

Seniors in the colleges of Cornell University who have completed the work required for the Bachelor's degree may, under certain conditions to be ascertained from the deans of their respective colleges, be admitted to the Graduate School.

## **REGISTRATION**

Students who have been admitted to the Graduate School are required to register in the office of the Graduate School and in the office of the Registrar of the University on the regular registration days of each term, unless special permission for later registration has been granted by the Dean.

## **STUDIES**

In carrying on studies in the Graduate School, the student is expected to assume the initiative and the responsibility. All courses of study offered in the University, and all the facilities for study and investigation afforded by its libraries, museums, and laboratories are open to graduate students in so far as they are qualified to make use of them. It is important, however, to recognize from the beginning that graduate work does not consist in the fulfillment of

routine requirements, and that the various opportunities for study, as well as the advice and assistance of teachers, are to be regarded simply as aids to the student in acquiring for himself the discipline and method of independent scholarship.

A brief statement of the provision made for graduate work by the various departments of the University will be found in this Announcement. A list of courses which are deemed likely to be of profit to graduate students is set down under the announcement of each department. More detailed information regarding these courses than is given here will be found in the separate Announcement of the college in which the particular course is given. The latest editions of the special Announcements of the various colleges may be obtained on application to the Secretary of the University.

The purpose of the Graduate School is to provide the student with the method and discipline of original research, to the ultimate end that he may contribute to the advancement of knowledge. In furnishing this opportunity for independent study and investigation, the Graduate School seeks to make the conditions such as will enable the student to devote himself wholly to his chosen field. Unhampered by restrictions that necessarily obtain in undergraduate work, he will come into freedom of association with older scholars, who will seek to make his work profitable to him by giving such aid and directions as he may need. Inasmuch as subjects differ greatly, the requirements for all subjects cannot be stated in terms at once specific and uniform. In some departments of knowledge original research may begin with the student's entrance into the School; in other subjects much preliminary work is necessary to fit the student for profitable research.

The branch of knowledge to which the student intends to devote the larger part of his time is termed his Major Subject. The other fields of study selected, which will be necessarily more restricted in their scope, and which should in general be selected with reference to their direct bearing upon the major subject, are termed the Minor Subjects. Candidates for the Doctor's degree are required to select a major subject and two minor subjects; for a Master's degree, a major subject and one minor subject are required.

In the case of candidates for an advanced degree it is required that a statement of the major and minor subjects, approved by the teachers under whose direction the work is taken, be presented to the Dean not later than two weeks after admission to the Graduate School. In the case of graduate students who are not candidates for an advanced degree, a detailed statement of the studies selected must be filed in the Dean's office not later than two weeks after registration. This statement is to be endorsed by a member of the Faculty who is selected by the student to act as his adviser.

### CANDIDACY FOR AN ADVANCED DEGREE

For a student who has been admitted to candidacy for an advanced degree the minimum time of residence for a Master's degree is one year, and for the Doctor's degree three years.

Not all students admitted to the Graduate School may expect to complete the residence requirements for an advanced degree in the minimum time. Those whose undergraduate work has been insufficient in amount or too narrowly specialized, as well as those whose preparation in their special field is inadequate, must



count upon spending some time in the preliminary studies which are essential as a basis for the advanced study and investigation that they propose to undertake. Moreover, it should also be remembered that the minimum residence requirement applies only to graduates of a four-year course in some college of Cornell University, and to graduates of other institutions who have pursued an equivalent course of study.

The conditions for admission to candidacy for an advanced degree are:

(a) The candidate's training must be substantially equivalent to that required for the first degree in one of the four-year courses at this University. Candidates for one of the advanced technical degrees, M.C.E., M.M.E., M.Arch., M.F., M.L.D., and M.S. in Agr., must have had the equivalent of the corresponding first degree at Cornell University.

(b) The candidate must receive the recommendation of his special committee that he is qualified to undertake such advanced work as the Faculty will accept for the degree.

### SPECIAL COMMITTEES

The work of each candidate for an advanced degree is in charge of a committee consisting of the teachers under whom his major and minor studies are pursued, the representative of his major subject being chairman. The student is expected to confer freely with the members of his special committee, not only in connection with individual courses of study, but also in regard to the general plan of his work.

### THE MASTER'S DEGREES

Cornell University confers the degrees of Master of Arts, Master of Science, Master of Architecture, Master of Civil Engineering, Master of Mechanical Engineering, Master in Forestry, Master in Landscape Design, and Master of Science in Agriculture.

After admission to candidacy for a Master's degree, the student must spend at least one year\* in residence at this University, pursuing under the direction of his special committee a course of advanced study including one major and one minor subject.

Each candidate must present a thesis, or essay, as the chairman of his special committee may decide, which shall demonstrate his ability to do independent work, and which shall be acceptable in style and composition. After this thesis, or essay, has been duly presented and is accepted by the Special Committee, the candidate is required to present himself for examination on his major and minor subjects and on the subject matter of his thesis.

A statement of the general subject of the thesis, or essay, with the written approval of the chairman of the special committee in charge of the candidate's

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\*In the case of graduate students who hold appointments as instructors or assistants in Cornell University, the minimum time of residence required for a Master's degree is increased by one-third. Students who are engaged in other outside work which reduces the time and thought that they are able to give to graduate work will also be required to devote more than the minimum time to their study for the Master's degree.

An instructor or assistant, who has completed at least one term of satisfactory graduate work at another university, may, however, upon the recommendation of his special committee, satisfy the residence requirements for the Master's degree by one year at Cornell.

work, must be filed in the office of the Dean at least six months before the date at which the degree is to be conferred.

The completed thesis, or essay, approved by the special committee, must be presented to the Dean at least five days before the examination for the degree, and must remain on file until the day preceding the examination. When the major subject for the degree of Master of Architecture is in Design, the candidate is required to deposit in place of the thesis, either the original drawings, or a photographic reproduction of them.

Each candidate for a Master's degree is required to furnish a bound typewritten copy of his thesis, or essay, for the use of the University Library, and this copy is to be delivered to the Dean not less than five days before the degree is to be conferred. The size of the page in the case of the typewritten thesis should be 8 x 10½ inches. This copy of the thesis becomes the permanent property of the Library.

Examinations for a Master's degree may be written or oral, or both, at the option of the examining committee, and are open to all members of the Faculty. The examination for the degree of Master of Architecture may be waived by the General Committee of the Graduate School in any case, where, in the opinion of the student's special committee, the major and minor subjects are of such a nature as to make an examination impossible or inexpedient.

### THE DEGREE OF DOCTOR OF PHILOSOPHY

The degree of Doctor of Philosophy is conferred upon a candidate who, after completing not less than three years of resident graduate work\*, presents a satisfactory thesis, and passes an examination on one major and two minor subjects, and on the subject matter of his thesis. Each candidate for the Doctor's degree is also required to deposit one hundred printed copies of his thesis with the Dean for the use of the University Library.

A candidate for the degree of Doctor of Philosophy is required to demonstrate his fitness by the presentation of a thesis which shall exhibit power of independent investigation, and by passing the required examinations in the fields represented by the major and minor subjects where he has carried on his studies during his term of residence. The Doctor's degree, however, is intended to represent, not a specified amount of work covering a specified time, but the attainment, through long study, of independent and comprehensive scholarship in special fields. The standard for the Doctor's degree is determined by the attainment to be expected of a student of ability and adequate preparation who devotes his entire time for three years to study and research, under proper supervision, in the field of study marked out by one major and two minor subjects. When the major subject for the doctorate is selected from the applied sciences, it is desirable as a general principle that the pure sciences most directly involved should be chosen as minor subjects.

A candidate for the Doctor's degree will ordinarily be expected to have a working knowledge of French and German before beginning graduate work. In all

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\*In the case of graduate students who hold appointments as instructors or assistants in Cornell University, the minimum time of residence for the Doctor's degree is four years. Students who are engaged in other outside work which reduces the time and thought that they are able to give to graduate study will also be required to devote more than the minimum time to candidacy for the Doctor's degree.

cases he must, before beginning his second year of residence, show to the satisfaction of his special committee that he possesses a reading knowledge of these languages. If the subjects chosen by a candidate are of such a character as to make it desirable that he should be familiar with some foreign language other than French and German, the special committee may, with the consent of the Dean, permit the substitution of that language for one of the two required.

The candidate is required to spend at least three years, after admission to candidacy, in resident graduate study and investigation of an advanced character. Residence as a graduate student in another university may, by permission of the Faculty, be accepted as the equivalent of residence at Cornell University. No general statement can be made regarding the conditions under which this permission will be granted; each case will be decided on its merits. A request for credit for resident work elsewhere must be approved by the student's special committee. At least one year's residence in Cornell University is required in all cases.

Ordinarily a student is expected to spend his full term of residence for an advanced degree at this (or some other) university. But there are certain cases where, in order to give the work of the Graduate School the greatest possible breadth, it is desirable, both from the standpoint of the student and of the University, to take advantage of opportunities for study and research not found in university centers. The conditions under which a candidate for the degree of Doctor of Philosophy may be allowed residence toward this degree for time spent in study away from the University have been stated in the following form by the legislation of the Faculty:

(1) Applicants must be regularly registered in the Graduate School as candidates for the Doctorate, and while not in residence shall receive no compensation except from the University. (2) They shall have spent at least two terms in Cornell University in study toward the Doctor's degree. (3) Permission to count such time as residence may be given by the Dean of the Graduate School for a period not to exceed one term, when the application is unanimously approved by the members of the student's Special Committee. When a longer period of outside study is required, applications for an extension of time should be made to the General Committee, which may, at its discretion, extend the period to two terms. In no event, however, shall a student acquire a total of more than two terms' residence under these provisions. (4) A student who avails himself of this privilege shall continue to work under the general direction of his Special Committee. Whenever possible, however, the work should be carried on under the immediate supervision of a competent director, acting for the Special Committee and to be designated by that Committee. (5) Reports regarding the progress of the work shall be made as directed by the Special Committee at intervals not in excess of one month.

Residence for a Master's degree may be credited toward the residence required for the degree of Doctor of Philosophy provided the special committee in charge of the work approves, certifying the work done as suitable for the Doctor's degree.

Candidates for the degree of Doctor of Philosophy are required to pass a Qualifying Examination, to be held normally not later than the close of the second year of residence. The legislation of the Faculty on this subject is given in the following paragraphs:

1. The qualifying examination or examinations, required of a candidate for the degree of Doctor of Philosophy shall be held at such time as his special committee may determine, normally not later than the close of the second year of residence. No candidate may proceed to his final examination until two terms have been completed after he has passed the qualifying examination.

2. The Special Committee shall pass upon the results of this examination as a whole, and shall report to the Dean whether the candidate has made satisfactory progress and is qualified to proceed in due order to complete the requirements for the degree.

3. The Special Committee, in the case of any candidate, may waive the qualifying examination in whole or in part; but the Committee shall nevertheless report to the Dean whether the candidate has made satisfactory progress and is qualified to proceed in due order to complete the requirements for the degree.

4. If a candidate fails to pass the qualifying examination, no re-examination shall be allowed except on the recommendation of the Special Committee.

A statement of the general subject of the thesis, with the written approval of the chairman of the special committee in charge of the candidate's work, is to be furnished the Dean at least six months before the date at which the degree is to be taken. The thesis for the Doctor's degree must be of such a character as to demonstrate the candidate's ability to do original work, and must be satisfactory in style and composition. The completed thesis, approved by the special committee, is to be presented at the office of the Graduate School at least five days before the examination for the degree, and must remain on file until the day preceding the examination.

Each candidate for the Doctor's degree is required to deposit one hundred printed copies of his thesis in the office of the Dean of the Graduate School for the purposes of the University Library. In exceptional cases this requirement may be met by depositing with the Dean for the purposes of the University Library a bound typewritten copy of the thesis, and one hundred printed copies of such a summary and such portion of the thesis as may be recommended by the chairman of the special committee and approved by the General Committee.

When all the other requirements for the doctorate have been fulfilled, the degree may be conferred before the printed copies of the thesis have been received, provided that the candidate present to the Dean, not less than five days before the degree is to be conferred, a bound typewritten copy of the thesis\*, together with a signed statement that publication will take place within a definite period, which period shall not exceed two years; and provided further that he deposit at the same time with the Treasurer of the University the sum of seventy-five dollars. The Treasurer is authorized to accept at his discretion as a guarantee, a regularly executed bond instead of the deposit of money.† The deposit will be returned if the prescribed number of printed copies of the thesis is furnished within the stated time. But, in case the printed copies are not delivered within

\*The size of the page in case of typewritten theses should be 8 x 10½ inches. This copy of the thesis becomes the permanent property of the Library.

†Attention is called to the ruling of the Trustees of the University that members of the Instructing Staff are not eligible as sureties on the bonds accepted in lieu of a deposit of money to secure publication of theses for the degree of Doctor of Philosophy.



such time, the University reserves the right to use the deposit to defray the expense of printing the thesis or such portions of it as the Faculty may direct.

The candidate should consult with the Dean regarding the form of publication of the thesis. The thesis shall have both a cover and a title-page. The title-page shall include the printed statement that the thesis is presented to the Faculty of the Graduate School of Cornell University for the degree of Doctor of Philosophy. If the thesis is a reprint, the place and date of the original publication must be given.

The attention of present and former graduate students of Cornell University is called to an arrangement whereby theses which have been accepted in fulfillment of the requirements for the doctorate at Cornell University may be published (at the expense of the authors) through the office of the Secretary of the University. The advantages of this arrangement to the writer of a thesis are: prompt and satisfactory publication, with the likelihood of moderate expense and the certainty of good printing; conformity of the individual thesis to a good style of typography and binding; ease of distribution, with the higher probability that a thesis will be sought and found when it is one of a series than when it is privately and separately published.

The writer whose thesis has been accepted by his special committee, and who wishes to avail himself of the arrangement in question, should apply to the chairman of that committee, who will make the necessary arrangements for publication through the chairman of the editorial committee.

To be distinguished from a candidate's special committee, which has charge of his examination and the preparation of a thesis, is the editorial committee which, under the arrangement described, will have charge of the publication of the thesis. This consists, in each case, of three members; the Dean of the Graduate School, the chairman of the special committee, and Professor Lane Cooper, the chairman of the editorial committee.

Examinations for the Doctor's degree may be either oral or written, or both, at the option of the examining committee, and are open to all members of the Faculty. A list giving the dates of the examinations and the members of the examining committees will be issued early in May.

Ordinarily the examination for the Doctor's degree follows the acceptance of the thesis and is held not earlier than the close of the sixth term of residence. If, however, the special committee certifies to the Dean that the candidate has made satisfactory progress on his thesis, and that it would be of advantage to have the examination precede the presentation of the thesis, the examination may be held at some date, set by the Dean, not earlier than two weeks before the close of the fifth term of residence. This examination must be followed by an examination, before the special committee as a whole, on the general subject matter of the thesis, at such time as may be designated by the Dean after the completed thesis has been duly presented in the office of the Graduate School. In the event of failure in this earlier examination, no re-examination may be held until three months after the completion of the minimum period of residence.



### DATES FOR CONFERRING DEGREES

Advanced degrees are conferred in February, June, and September.

In February, degrees will be conferred on students who have made application for the degree on or before the first day of instruction after the Christmas recess, and who have completed the requirements not later than the last day of the final term examinations.

In June, degrees will be conferred on students who have made application for the degree not later than May 15, and who have completed the requirements not later than the last day of the final term examinations.

In September, degrees will be conferred on students who have made application for the degree not later than September 1, and who have completed the requirements not later than the day preceding the first day of instruction of the first term.

### GRADUATE WORK IN THE SUMMER

*All students pursuing graduate studies during the summer under any of the provisions described in the following paragraphs are required to enroll both with the Registrar of the University and in the office of the Dean of the Graduate School before beginning work.*

(A) **The Summer Session.** Work done in the Summer Session of Cornell University, under the direction of a member of the Faculty of the Graduate School, may be counted for residence toward the degree of Master of Arts under the following conditions: one term's residence to be satisfied by two summer sessions, and two terms' residence by four summer sessions. Candidates for this degree who are in residence during Summer Sessions only are required also to continue their studies during the year under the direction of the Chairman of the Special Committee in charge of their work.

It should be noted that in some departments no graduate work is offered in the Summer Session. A statement of the graduate work offered will be found in the Announcement of the Summer Session, which will be sent on application to the Secretary of the University.

(B) **The Third Term.** A Third Term, which is usually about twelve weeks in length, extending from June to September, is offered by certain departments in the College of Agriculture. For the purposes of graduate residence this term is regarded as equivalent to an equal period during the academic year. No candidate for the Doctor's degree, however, will be credited with more than two terms of residence during any twelve consecutive months, and no candidate will be recommended for this degree at an earlier date than if all his work had been done during the regular sessions of the academic year. The Announcement of the Third Term may be secured by application to the Secretary of the University.

(C) **Personal Direction.** An opportunity is offered to properly qualified students of certain subjects to carry on graduate studies during the summer months under the personal direction of members of the Faculty of the Graduate School. The general library and many of the laboratories and special libraries of the University are open during this period, and certain members of the instructing staff, who remain in residence during the summer, are willing to assume

responsibility for the supervision of the work of students who are qualified to carry on investigations. It is impossible to make any announcement in advance as to what opportunities for graduate work may be found at any definite time in a particular subject; but such information may be obtained by correspondence.

Residence towards an advanced degree for work carried on under personal direction during the summer will be granted only if the following conditions are complied with:

1. Members of the Faculty of the Graduate School who are prepared to undertake the direction during the summer months of the studies of graduate students who are registered neither in the Summer Session nor in the Third Term, may obtain authorization for such work by making application to the General Committee not later than May 1 of each year. An application for such authorization should contain a statement regarding the number of weeks during which the member of the Faculty is prepared to undertake the supervision of this work.

2. A student who has already completed at least a full year of graduate work as a candidate for an advanced degree, either in this University or in some institution whose graduate work is acceptable, may receive residence credit for work thus authorized. It should, however, be understood that this provision for residence credit in all cases is limited by the general rule that graduate students are required to register both in the office of the Registrar of the University and in that of the Dean of the Graduate School, and by the rule that no candidate for the Doctor's degree will receive credit for more than two terms of residence during any twelve consecutive months.

(D) Under conditions to be ascertained from the Dean, instructors in Cornell University who are also registered in the Graduate School may receive credit for work done without compensation during the summer months away from the University.

## FELLOWSHIPS AND GRADUATE SCHOLARSHIPS\*

The following twenty-four fellowships are annually offered in the Graduate School:

1. The Cornell Fellowship in English.
2. The McGraw Fellowship in Civil Engineering.
3. The Sage Fellowship in Chemistry.
4. The Schuyler Fellowship in Physiology; Vertebrate Zoology, including Anatomy and Histology and Embryology; or Invertebrate Zoology and Entomology.
5. The Sibley Fellowship in Mechanical and Electrical Engineering.
6. The Goldwin Smith Fellowship in Botany; Geology; or Physical Geography.
7. The President White Fellowship in Physics.
8. The Erastus Brooks Fellowship in Mathematics.
9. The University Fellowship in Architecture.

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\*It is possible that, during the year 1921-1922, some modifications may be made in the list of fellowships and graduate scholarships and in the stipends attaching to them. In cases where any such change is made applicants will be informed by correspondence.

10. The University Fellowship in Romance Languages.
11. The University Fellowship in German.
12. The University Fellowship in Agriculture.
13. The Charles Bull Earle Memorial Fellowship in Mechanical and Electrical Engineering.
14. The President White Fellowship in Modern History.
15. The President White Fellowship in Political and Social Science.
- 16-17. The Susan Linn Sage Fellowships in Philosophy.
18. The Susan Linn Sage Fellowship in Psychology.
- 19-20. The Fellowships in Political Economy.
- 21-22. The Fellowships in Greek and Latin.
23. The Fellowship in American History.
24. The Edgar J. Meyer Memorial Fellowship in Engineering Research.

The President White Fellowships in Modern History and in Political and Social Science have an annual value of \$500 each; the others have an annual value of \$400 each. All Fellows are also exempt from tuition.

In addition to the fellowships enumerated above, the Faculty of the Graduate School awarded for the year 1920-1921 two fellowships in Physics of \$500 each, and a fellowship of \$750 in Chemistry. The Fellowships in Physics are supported by the income of the Susan Phelps Gage Fund for research in Physics which, by the decision of the professors in the department of Physics, was devoted to this purpose for the year of 1920-1921. The Fellowship in Chemistry, supported by the E. I. DuPont de Nemours and Company, is known as the DuPont Fellowship. At the present time the following special fellowships have also been awarded by the Faculty of the Graduate School: The Eden Valley Fellowship, the Hampton Potato Growers' Fellowship, the Herman Frasch Fellowship (which provides for two fellows) the North Fork Fellowship, the Steuben County Seed Improvement Fellowship, the Williamson Vegetable Laboratory Association Fellowship, the Wilson Growers' Fellowship, the Grasselli Fellowship in Chemistry, supported by the Grasselli Chemical Company of Cleveland, Ohio, and the Chautauqua County Tomato Improvement Fellowship. It is impossible at the present time to announce these fellowships as annually awarded to applicants. Information in regard to them may at any time be obtained by correspondence with the respective departments.

The following seventeen graduate scholarships are annually offered in the Graduate School:

- 1-5. The Susan Linn Sage Graduate Scholarships in Philosophy.
6. The Susan Linn Sage Graduate Scholarship in Psychology.
7. The Graduate Scholarship in Mathematics.
8. The Graduate Scholarship in Chemistry.
9. The Graduate Scholarship in Physics.
10. The Graduate Scholarship in Civil Engineering.
11. The Graduate Scholarship in Latin and Greek.
12. The Graduate Scholarship in Archaeology and Comparative Philology.
13. The Graduate Scholarship in Physiology; Vertebrate Zoology, including Anatomy and Histology and Embryology; or Invertebrate Zoology and Entomology.

14. The Graduate Scholarship in Botany; Geology; or Physical Geography.
15. The Graduate Scholarship in English.
16. The Graduate Scholarship in History.
17. The Graduate Scholarship in Architecture.

The graduate scholarships, with the exception of the Scholarship in Architecture, have an annual value of \$200 each. Holders of graduate scholarships are also exempt from tuition. The Graduate Scholarship in Architecture grants only free tuition.

All persons elected to fellowships and graduate scholarships are required, upon accepting their appointments, to file a bond, that in case of their resignation before the expiration of the time for which they were appointed, they will repay to the University any sums that they may have received. The bond must be for the value of the fellowship or the scholarship and must have two sureties approved by the Treasurer of the University. Attention is called to the ruling of the Trustees of the University that members of the Instructing staff are not eligible as sureties on the bonds required by the University from holders of Fellowships and Graduate Scholarships.

Students holding fellowships and graduate scholarships are not free to accept other appointments, but will be expected to devote their time uninterruptedly to the prosecution of their studies.

The moneys due on fellowships and graduate scholarships are paid at the office of the Treasurer of the University in six equal payments on October 15, December 1, January 15, February 15, April 1, and May 15.

The term of each fellowship and graduate scholarship is one year, but the term may under exceptional circumstances be extended to two years.

On the recommendation of the Faculty of the Graduate School a fellowship may be divided for a single year into two graduate scholarships, the value of each to be one-half of the divided fellowship. But no fellowship may be thus divided oftener than once in two years.

The President White Fellowships in History and Political Science may, in the discretion of the Faculty of the Graduate School, be made traveling fellowships. The holders of these fellowships may by the terms of the gift be called upon to render certain services in connection with the President White Library. In the case of a student of very exceptional ability and promise in the fields of either of these fellowships, the two fellowships may, in the discretion of the Faculty, be combined for a single year into one.

Official forms for making application for fellowships and graduate scholarships may be obtained from the Dean of the Graduate School. All applications should be filed in the office of the Dean on or before March 15 of the academic year preceding the one for which application was made. Before this application is filed, the applicant should have convinced himself by correspondence that he is eligible for admission to the Graduate School of this University in full standing, since appointments are given only to those who are eligible for admission to candidacy for an advanced degree.

All other information, papers, and testimonials should be submitted on or before March 15 to the department in which the applicant desires to carry on



the principal part of his work. Applicants are advised to submit any published or unpublished papers or reports showing the result of their study or research which might serve to indicate the extent of their knowledge of the subject, or their command of the methods and tools of research, or their capacity generally for clear written expression. Candidates who are graduates of other colleges or universities should submit recommendations from the instructors best acquainted with their ability and attainments. It should be borne in mind that information cannot be too exact or detailed in the case of students not personally known to the appointing body.

### **Honorary Fellowships**

Persons upon whom the Doctor's degree has already been conferred, or persons who have a recognized standing as scholars or investigators equivalent to that degree, may, in the discretion of the Faculty of the Graduate School, be appointed to honorary fellowships. These fellowships cover all fees except laboratory charges. Actual residence at the University and regular registration in the Graduate School are required of appointees.

### **THE GRADUATE PRIZE IN PHILOSOPHY**

The Graduate Prize in Philosophy has an annual value of about twenty-five dollars, and is open for competition to all students registered in the Graduate School of Cornell University.

1. The prize will be awarded to the graduate student who submits the best paper embodying the results of research in the field of philosophy. To be acceptable, the paper must show independent scholarship and research in dealing with philosophical ideas. The subject of the paper may be either historical or critical and constructive in character. It may be concerned either with problems of pure philosophy or with the philosophical bearing of the concepts and methods employed in mathematics or in any of the natural or humanistic sciences.

2. Papers submitted in competition must be deposited in the office of the Dean of the Graduate School on or before the first day of May. Each paper is to be typewritten, and must bear a fictitious signature and be accompanied by the name of the writer in a sealed envelope.

3. The prize will be awarded by a committee appointed by the President of the University. A copy of the successful paper is to be deposited in the University Library by the Dean of the Graduate School.

### **FEEES**

*A student who fails to pay his indebtedness to the University within twenty days after the last registration day of the term is thereby dropped from the University.*

*Any tuition fee or other fee may be changed by the Trustees to take effect at any time without previous notice.*

**A Matriculation Fee** of \$10 is charged all students on entering the University; this fee must be paid at the time of registration.

**An Infirmary Fee** of \$5 a term is required of all students (except those registered in the Medical College in New York City) at the beginning of each term.



(For a statement of the privileges given in return for this fee, see the *General Circular of Information*, p. 52.)

An **Administration Fee** of \$25 for the academic year is required of all students registered in the Graduate School. This fee is payable in installments of \$12.50 each semester.

A **Tuition Fee** of \$75 for the academic year is to be paid by all students registered in the Graduate School except those exempted under one of the following headings:—

(1) Graduate students holding appointments as University Fellows or Graduate Scholars.

(2) Graduate students holding appointments as assistants and instructors and having their major studies in the college or line of work in which they are instructing, are exempt from the payment of tuition fees and laboratory and shop fees in the department in which they are employed to give instruction; members of the instructing staff who take work for which they must pay tuition are required to pay in proportion to the amount of work for which they are registered.

(3) Graduate students who at the beginning of the college year are and for at least twelve months prior thereto have been *bona fide* residents of the State of New York and whose major work is taken in departments connected with the New York State College of Agriculture or the New York State College of Veterinary Medicine.

A **Graduation Fee** of \$20 is required, at least ten days before the degree is to be conferred, of every candidate for an advanced degree. The fee will be returned if the degree is not conferred.

Every person taking laboratory work or courses where a fee is charged must pay to the Treasurer the required fee or the required deposit for the materials, etc., to be used in the work.

No student may receive the master's degree who has not paid the tuition fee for at least one year, and no one may receive the doctor's degree who has not paid the tuition fee for at least three years, unless one or more of the years spent in study for the doctor's degree have been spent in graduate study at another university, or unless payment of tuition has been waived under one of the foregoing headings.

Any student in the Graduate School who has completed the requirement of residence for the degree for which he is a candidate, whose studies have been satisfactory to the faculty, and who during that time has satisfied the requirements as to tuition fees, is, on paying the annual administration fee, exempt from the further payment of tuition fees for a period not to exceed one year.

### **Fees During the Summer**

**The Third Term in the College of Agriculture.** For this term, which is usually about twelve weeks in length, students registered in the Graduate School are charged an Administration Fee of \$10 and a Tuition Fee of \$27.50.

Members of the instructing staff during the two terms immediately preceding, having their major studies in the college or line of work in which they are instruct-

ing, are exempt from the charge for tuition. It, during the academic year just preceding they have paid the full administration fee of \$25 they are not required to pay this fee for the third term.

**The Summer Session and Summer School in Agriculture.** Students of the University Summer Session and the Summer School in Agriculture who have been admitted to candidacy for an advanced degree are required to pay the regular tuition of the Session (\$40) but are exempt from tuition and administration fees in the Graduate School. On registering for the first time as a candidate, a student who has not previously matriculated in Cornell University will be given matriculation without payment of the usual fee on presenting a certificate that he has paid the tuition charges for the current Summer Session.

Students registered in the Graduate School, excused from tuition in the Summer School in Agriculture as residents of New York State, are charged on their first registration in the Graduate School a Matriculation Fee of \$10, and for each session an Administration Fee of \$6.25.

**Personal Direction.** Students carrying on studies during the summer as candidates for advanced degrees under Personal Direction are required to register with the Registrar as well as in the Graduate School, and to pay an administration fee of \$10.

No administration fee is required of persons who have been regularly appointed members of the instructing staff during the preceding academic year and who have during that year paid the full administration fee.

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## THE UNIVERSITY LIBRARIES

WILLARD AUSTEN, Librarian; A. C. WHITE, Assistant Librarian; G. L. BURR, Librarian of the President White Library; HALDOR HERMANSSON, Curator of the Icelandic Collection; ———, Curator of the Dante and Petrarch Collections; E. R. B. WILLIS, Superintendent Readers' Division, General Library; E. E. WILLEVER, Librarian of the Law Library; W. W. ELLIS, Librarian of the Agricultural College Library.

The University Libraries comprise the General Library of the University, the Seminary Libraries in the general library building, the Architectural Library, the Chemical Library, the Sibley Engineering Library, the Civil Engineering Library, the Law Library, the Flower Veterinary Library, the Barnes Reference Library, the Goldwin Smith Hall Library, the Stimson Hall Medical Library, and the Library of the New York State College of Agriculture. The total number of bound volumes in them is now over six hundred thousand. The number of periodicals, transactions, and other serials, currently received, is over two thousand, and of most of these complete sets are on the shelves.

Among the more important special collections in the General Library may be mentioned:

**THE ANTHON LIBRARY**, of nearly seven thousand volumes, the collection made by the late Professor Charles Anthon, of Columbia College, in the ancient classical languages and literatures, besides works in history and general literature.

**THE BOPP LIBRARY**, of about twenty-five hundred volumes, relating to the oriental languages and literatures, and comparative philology, being the collection of the late Professor Franz Bopp of the University of Berlin.

**THE GOLDWIN SMITH LIBRARY**, of thirty-five hundred volumes, comprising chiefly historical works and editions of the English and ancient classics, presented to the University in 1869 by the late Professor Goldwin Smith, and increased during later years by the continued liberality of the donor.

**THE WHITE ARCHITECTURAL LIBRARY**, a collection of over twelve hundred volumes relating to architecture and kindred branches of science, given by the late President White.

**THE KELLY MATHEMATICAL LIBRARY**, comprising eighteen hundred volumes and seven hundred tracts, presented by the late Hon. William Kelly, of Rhinebeck.

**THE SPARKS LIBRARY**, being the library of Jared Sparks, sometime President of Harvard University, consisting of upward of five thousand volumes and four thousand pamphlets, relating chiefly to the history of America.

**THE MAY COLLECTION**, relating to the history of slavery and anti-slavery, the nucleus of which was formed by the gift to the library of the late Rev. Samuel J. May, of Syracuse.

**THE SCHUYLER COLLECTION** of folk-lore, Russian history and literature, presented by the late Hon. Eugene Schuyler in 1884.

**THE PRESIDENT WHITE HISTORICAL LIBRARY**, of about twenty-three thousand volumes and pamphlets, the gift of the late President White, received in 1891, especially rich in the primary sources of history, and containing notable collections on the period of the Reformation, on the English and French Revolutions, on the American Civil War, and on the history of superstition.

**THE SPINOZA COLLECTION**, numbering four hundred and fifty volumes, presented in 1894, by the late President White.

Four remarkably rich collections given by the late Willard Fiske, comprising the **DANTE COLLECTION**, containing over eight thousand volumes, the **PETRARCH COLLECTION**, containing about four thousand volumes, the **RHAETO-ROMANIC COLLECTION**, containing about thirteen hundred volumes, and the **ICELANDIC COLLECTION**, containing over fifteen thousand volumes.

**THE ZARNCKE LIBRARY**, containing about thirteen thousand volumes and pamphlets, especially rich in Germanic philology and literature, purchased and presented in 1893 by William H. Sage.

**THE HERBERT H. SMITH COLLECTION** of books relating to South America, purchased in 1896.

A valuable collection of books on French and Italian Society in the 16th and 17th centuries, presented by Professor T. F. Crane in 1896.

**THE FLOWER VETERINARY LIBRARY**, the gift of ex-Governor Flower to Cornell University, for the use of the State Veterinary College, in 1897.

**THE EISENLOHR LIBRARY**, containing about one thousand volumes of Egyptology and Assyriology purchased and presented in 1902 by A. Abraham.

**THE BAYARD TAYLOR** correspondence and journals and his collection of Goethe literature, presented to the Library, in 1905 by Mrs. Marie Taylor.

**THE ANGLO-SAXON COLLECTION** and the **COWPER COLLECTION** formed by the late Professor Hiram Corson, bequeathed to the Library, and received in 1911.

**THE ENGLISH COLLECTION** presented by Professor J. M. Hart in 1914.

**THE GUTEAU INSURANCE LIBRARY**, purchased in 1916.

**THE CHARLES WILLIAM WASON COLLECTION** of books dealing with China and the Chinese, bequeathed to the University by C. W. Wason, '76, in 1918.

**THE JAMES VERNER SCAIFE COLLECTION** dealing with the Civil War in the United States, given by J. V. Scaife, '89, in 1919.

**THE BERNARD A. SINN COLLECTION** of naval biography and history, given by B. A. Sinn, '97, in 1919.

**THE ROLLIN A. HARRIS COLLECTION** of mathematical books given for the use of the Mathematics Department by Mrs. R. A. Harris.

**THE EMIL KUICHLING COLLECTION** of works dealing with sanitary science given for the use of the Engineering College by Mrs. Kuichling.

**THE LAW LIBRARY** of forty-seven thousand volumes contains an unusually complete collection of American, English, and Colonial reports, with complement of textbooks and statutes, and complete sets of all leading periodicals in English.

These collections, and others such as these, making possible an exhaustive study of certain fields, are of the greatest service in research work. A similar purpose is served by the seminary rooms of the University Library. Thus, for the study of English, of the classical languages, of the Germanic and Romance languages, of philosophy, of politics and economics, of American and of European history, there have been provided in the library building seven of these research rooms, each equipped with a carefully chosen body of reference books, to which advanced students in these fields have access. In connection with the scientific and technical laboratories similar collections have been formed and well supplied with reference books, standard works, and sets of periodicals, conveniently arranged for study and research.

Cards of admission to the shelves in the stackrooms and to the White Historical Library will be issued to graduate students for the purpose of consultation and research. The privilege of taking books for home use is granted to all students who comply with the library regulations.

**Lectures in Bibliography.** As a part of the work of the General Library Mr. Willis offers a series of informal talks to graduate students in the Second Term on the resources and facilities of the Library and on the employment as aids to research of the general bibliographical helps.



## **COURSES OF INSTRUCTION AND OTHER OPPORTUNITIES FOR GRADUATE STUDY**

The courses outlined in the following pages are grouped primarily on the basis of subject matter. Under each subject there is usually given, in a separate paragraph, a list of courses which are probably too elementary in character to interest graduate students of that subject. There then follows a list of all those courses which, whether open or not open to undergraduates, are deemed likely to be of profit to graduate students.

More detailed information concerning any one of these various courses (time and place of meeting, and in the case of a few courses given in alternate years, whether or not offered in 1921-1922, etc.) will be found in the separate announcement of the college in which the particular course is given. The latest edition of these special announcements of the various colleges may be obtained on application to the Secretary of the University.

### **SEMITIC LANGUAGES AND LITERATURES AND ORIENTAL HISTORY**

**Professor: NATHANIEL SCHMIDT.**

Special facilities for advanced work in these subjects are: (1) a collection of several hundred squeezes of inscriptions found in Syria, and Arabia Petraea, chiefly in Arabic, Hebrew, Syriac, Assyrian, Nabataean, and Greek; (2) squeezes of Old Egyptian, Coptic, and Hittite inscriptions; (3) a collection of several thousand photographs taken in Syria and Arabia Petraea and slides taken from these photographs; (4) reproductions of inscriptions and objects of art in the Museum of Casts; (5) a valuable collection of Arabic, Hebrew, Samaritan, Ethiopic, and Coptic manuscripts secured in Syria; (6) the Eisenlohr Library, especially rich in Egyptology; (7) the Fiske collection of Arabic books; (8) a growing collection of Egyptian antiquities.

To the candidate for an advanced degree, opportunities are offered of studying every Semitic language and dialect, and also Sumerian, Old Egyptian, and Coptic. The student may, if he so chooses, specialize in Semitic literature or in Oriental history. A candidate for the Master's degree or the Doctor's degree, with Semitic languages as a major subject, must have had a year of elementary Hebrew or Arabic; and a candidate for either of these degrees, with Oriental history as a major subject, must have had one year of ancient history and one year either of the history of Asia or the history of Africa, before entering upon the graduate course.

Advanced Hebrew.

Neo-Hebraic.

Ethiopic.

Assyrian.

Sumerian.

Aramaic (Mandaic, Babylonian Talmudic, Syriac, Nabataean, Palmyrene, Galilaeen, Samaritan, and Judaeen).

Arabic (Sabaean and Minaean, Classical, Modern).



Egyptian.

Coptic.

Comparative Semitic Philology.

Semitic Epigraphy (in Semitic Seminary).

Hebrew Literature (in Semitic Seminary).

The History of Asia.

The History of Africa.

The Sources of Oriental History (in Historical Seminary).

### GREEK

Professors: G. P. BRISTOL; H. L. JONES.

Reader: A. C. WHITE.

The general library and the special library of over two thousand volumes in the seminary rooms afford ample facilities for graduate work. The special library is rich in complete sets of philological and archaeological periodicals in various languages, and contains all the standard works that form the laboratory apparatus of the graduate student. Other books will be transferred from the general library to the seminary rooms as they are needed.

The one essential preparation for graduate work is the ability to read Greek. To gain this the student should pursue the subject throughout his undergraduate course, reading the largest possible amount of Attic prose literature. A good reading knowledge of Latin, German, and French is very helpful. All courses offered in Greek are open to any graduate student, but not all courses will be accepted as graduate work leading to a degree.

Elementary Greek with Xenophon; Selections from Plato and the Odyssey; Herodotus; Demosthenes, Aeschylus, Sophocles; Greek Composition; Thucydides; The New Testament; Lyric poetry; Aristophanes.

The Myths of the Epic Cycle. Professor JONES.

Advanced Greek Composition. Professor JONES.

The Orestean Tragedies of Aeschylus, Sophocles, and Euripides. Professor JONES.

Greek Seminary. Homer, Oratory, or History. Professor BRISTOL.

Comparative and Historical Grammar. Professor BRISTOL.

### GREEK ART AND ANTIQUITIES

Professor: E. P. ANDREWS.

The Museum of Casts furnishes abundant material for the study of Greek sculpture and for most branches of Greek archaeology. Several hundred squeezes bring the most important Greek inscriptions within reach for independent work in Greek epigraphy. The University Library contains complete sets of the most important archaeological periodicals.

Ability to read French and German, as well as Greek and Latin, is necessary. A scholarship in archaeology and comparative philology is awarded annually.

Elementary Courses: History of Greek Sculpture; Greek Archaeology; Greek Numismatics; Greek Architecture.

Graduate Courses: Greek Epigraphy in Seminary.

Greek Archaeology, in Seminary.

History of Greek Sculpture, in Seminary.

Modern Greek, Written and Colloquial.

Pausanias, and the Topography of Greece, with especial reference to Athens.

## LATIN

Professors: C. E. BENNETT; H. C. ELMER; C. L. DURHAM.

Graduate students in Latin have the use of the Latin seminary, consisting of two rooms in the University Library. The seminary contains several thousand volumes of texts and other works of reference, including complete sets of all the journals of classical philology. Two Greek and Latin fellowships and one scholarship are awarded annually.

Any student who has specialized in Latin for four years as an undergraduate in a college of recognized standing may be admitted to graduate work in the following courses. A reading knowledge of French and German is, however, indispensable to their prosecution.

41. **Latin Seminary.** Professor BENNETT. T, 2, and S, 10, Library Greek and Latin Seminary Room.

The work of the seminary for 1920-1921 consisted of the textual and exegetical study of Horace, combined with the reading of all Horace's works.

The object of the seminary is to familiarize its members with the methods and habits of independent investigation. The work, therefore, as far as possible, is thrown into the hands of the students themselves.

42. **History, Aim, and Scope of Latin Studies.** Throughout the year. Professor BENNETT. T Th, 10, Goldwin Smith 120.

This course will present the history of Latin study since the Renaissance, will outline the various fields of investigation, showing the present state of knowledge in each, along with the chief problems still awaiting solution, and will give a very full bibliography.

43. **Historical Latin Syntax.** Professor BENNETT.

Lectures on the moods and tenses of the Latin verb, with special reference to the subjunctive,—its primitive meaning and its development in subordinate clauses.

44. **Historical Grammar of the Latin Language.** Throughout the year. Professor BENNETT.

Lectures and exercises on the sounds and inflections of the Latin language from the historical point of view.

45. **Latin Writing, Advanced Course.** Throughout the year. Professor ELMER. Th, 3, Goldwin Smith 124.

48. **Vulgar Latin.** Throughout the year. Professor DURHAM. Goldwin Smith 128.

A study of the extension of the Latin language to the Roman provinces and an investigation of the phonology, the flexions, and the syntax of vulgar Latin.

49. **Cicero's Orator**, with special reference to his doctrine of prose rhythm. Throughout the year. Professor DURHAM. Goldwin Smith 128.

50. **Latin Epigraphy**. Throughout the year. Professor DURHAM. Goldwin Smith 128.

### GERMAN

Professors: A. B. FAUST; A. W. BOESCHE; P. R. POPE; A. L. ANDREWS.

In the advanced courses in this subject the work is twofold, literary and philological. The history of German literature from the earliest period to the present day is sketched in outline lecture courses with collateral reading. Special topics are selected for detailed study, such as the epic and lyrical poetry of the Middle High German period, the literature of the Reformation, the classical period, the drama of the nineteenth century and contemporary literature. The courses offered in philology include the study of Gothic, Old and Middle High German, and Old Saxon. They afford also an introduction to the science of language and the principles of phonetics.

The seminars in German literature and philology aim to impart the principles and methods of investigation. A teachers' course deals with class-room methods and theories of instruction in the modern languages.

All the work in German is greatly facilitated by an exceptional library equipment. The nucleus was formed by the acquisition of the Zarncke library, one of the largest collections of rare books for the study of German literature and philology ever brought to America. With constant enlargements the library has become one of the most serviceable in the country. The German seminary room in the University Library contains books for ready reference, including philological journals and reviews.

Candidates for advanced degrees in German are expected to have an adequate knowledge of French and Latin. A fellowship in German is awarded annually.

Elementary German; Second, and Third German Course; Intermediate German Course; Elementary German Composition and Conversation; Advanced German Composition and Conversation; Scientific German.

Schiller's Life and Works. Professor BOESCHE.

Goethe's Life and Works. Professor POPE.

Goethe's Faust. Professor FAUST.

History of German Literature. Professor FAUST.

Contemporary German Literature. Professor FAUST.

Lessing's Life and Works. Professor POPE.

Topics in Historical German Syntax. Professor BOESCHE.

Middle High German. Assistant Professor ANDREWS.

Gothic. Professor BOESCHE.

Old High German. Professor BOESCHE.

Principles of Germanic Philology. Assistant Professor ANDREWS.

Teachers' Course. Professor FAUST.

Seminary in German Literature.

Seminary in Germanic Philology.

## SCANDINAVIAN LANGUAGES AND LITERATURES

Professor: HALLDOR HERMANSSON.

The Fiske Icelandic Collection in the University Library, comprising about 15,000 books and pamphlets, offers excellent facilities for advanced work in Old Norse-Icelandic language and literature, Norse mythology and heroic legends, runology, and early Scandinavian history, as well as in Modern Icelandic language and literature. The Library also has a small collection of books on the other modern Scandinavian languages and literatures to which some additions are made annually.

Old Icelandic.

History of the Old Norse-Icelandic literature.

Norse mythology.

Early Scandinavian history.

Modern Scandinavian languages and literatures.

## ROMANCE LANGUAGES AND LITERATURES

Professors: J. F. MASON; G. L. HAMILTON; O. G. GUERLAC; R. H. KENISTON; L. PUMPELTY.

Instructors: E. H. HESPELT; L. L. ATWOOD; P. R. SANJURJO; M. ZAPATA Y TORRES; H. C. BERKOWITZ; A. H. CURY; L. F. DOW.

The collection of French and Spanish books in the University Library is very large, and offers excellent facilities for advanced work. Objects of special pride are the unrivalled Dante and Petrarch collections, the gift of the late Willard Fiske, who likewise presented to the University a unique collection of Rhaeto-Romance works. Smaller collections of Portuguese and Provençal books are also to be found in the University Library. The seminary library contains several thousand volumes including many sets of bound periodicals. A university fellowship (of the value of \$400 and free tuition) in Romance languages is annually awarded.

The courses of study in this department are divided into three categories: those intended primarily for undergraduates, those intended alike for undergraduates and graduates, and those intended primarily for graduates. All candidates for advanced degrees in this department must possess a thorough reading knowledge of Latin, French, and German, before announcing their candidacy. A graduate student in Romance languages should have completed some formal course of study in the language and literature of the language which he intends to select as his major subject, and should have a reading knowledge at least of the languages which he selects as his minor subjects.

A candidate for the degree of Master of Arts whose major subject is in Romance languages is expected to present for the approval of the chairman of his special committee, within two weeks after registration day, an outline of the work planned for the year. The thesis, must, before May 1, be submitted for the criticism of the chairman of the candidate's special committee. If not already taken, a course in the philology of the language which constitutes their major subject is required of graduate students in their first year of study.

Candidates for the degree of Doctor of Philosophy are expected to follow advanced courses given in the field in which their major subject lies and to take up such work as will give a comprehensive view of the fields in which their minor subjects lie. It is intended that the last year of preparation for this degree shall be spent chiefly upon the thesis. Further information may be obtained from the professors in this department.

First Year French; Second Year French; Third Year French; Fourth Year French; Elementary French Composition; Advanced French Composition; First Year Italian; Second Year Italian; First Year Spanish; Second Year Spanish; Third Year Spanish; Fourth Year Spanish; Elementary Spanish Composition; Advanced Spanish Composition.

History of French Literature. Professor MASON and Professor GUERLAC.

French Literature of the Sixteenth Century. Professor MASON.

French Literature of the Seventeenth Century. Professor GUERLAC.

French Literature of the Eighteenth Century. Professor MASON.

French Literature of the Nineteenth Century. Professor MASON.

Medieval French Literature. Professor HAMILTON.

Romance Phonetics. Professor KENISTON.

French Philology. Assistant Professor PUMPELLY.

Voltaire and His Time. Professor GUERLAC.

France of To-day: A study of some social and political aspects of France after the war. Professor GUERLAC.

Modern French Literature Seminary. Professor MASON.

Old Italian. Professor HAMILTON.

Spanish Literature of the Nineteenth Century. Dr. SANJURJO.

Spanish Classical Literature. Professor KENISTON.

History of Spanish Literature. Professor KENISTON.

Low Latin. Professor HAMILTON.

Old French Texts. Professor HAMILTON.

Old Spanish. Professor KENISTON.

Spanish Seminary. Professor KENISTON.

Old Provençal. Professor HAMILTON.

Portuguese Grammar and Reading. Professor KENISTON.

## ENGLISH

Professors: M. W. SAMPSON; W. STRUNK, JR.; LANE COOPER; F. C. PRESCOTT; C. S. NORTHUP; J. Q. ADAMS, JR.; B. S. MONROE; L. N. BROUGHTON; F. M. SMITH.

Instructors: J. W. HEBEL; F. M. FISKE; T. S. LONG; F. MANNING SMITH; H. V. HOTCHKISS; G. D. SANDERS; M. MARX; J. H. NELSON; D. L. BALDWIN; J. B. REEVES; G. R. VAN ALLEN; W. H. FRENCH; C. B. HALE; W. P. JONES; L. K. ELMHIRST; C. HARRIS.

Among the books available to the student are complete sets of the publications of the Early English Text, Chaucer, Scottish Text, Percy, English Dialect, Shakespeare, New Shakspeare, Spenser, Philological, Malone, and other societies; of the Arber, Bullen, Grosart, and Farmer reprints; and of all the important



periodicals dealing with the English language and literature. Most of the American and foreign dissertations on English subjects, standard and other editions of individual authors, English and American, and several special collections, are also in the Library, which is exceptionally rich in the field of Old and Middle English, and in the Elizabethan and Victorian periods. The Hart Memorial Library, founded by the late Professor J. M. Hart, contains valuable collections in the bibliography of English philology. This library (Morrill 32) is for the use of graduate students and members of the Faculty. The Department has also a seminary room in the University Library. A fellowship and a scholarship are annually awarded. The Cornell Studies in English, a series of monographs issued by the Department, affords some opportunity for the publication of work accomplished by graduates as well as by members of the staff. Five volumes have appeared:

1. A Bibliography of Thomas Gray. By Clark Sutherland Northup. 1917.
2. The Influence of Horace on the Chief English Poets of the Nineteenth Century. By Mary Rebecca Thayer. 1916.
3. The Dramatic Records of Sir Henry Herbert, Master of the Revels, 1623-1673. Edited by Joseph Quincy Adams, jr. 1917.
4. A Geographical Dictionary of Milton. By Allan H. Gilbert. 1919.
5. Italian Social Customs of the Sixteenth Century and Their Influence on the Literature of Europe. By Thomas Frederick Crane. 1920.
6. [In press] The Ben Jonson Allusion Book. By J. Franklin Bradley and Joseph Quincy Adams, jr. 1921.

Candidates for an advanced degree may take their major subject in literature or in language. In general, thirty-six hours (i. e., three full years) of college English are required before a student may enter upon candidacy for an advanced degree. Work in philosophy, history, and languages, ancient and modern, may, at the discretion of the candidate's special committee, be counted against a shortage in undergraduate English. Training in the Greek and Latin literatures is especially desirable as a preparation for graduate work in English. All candidates must complete a satisfactory amount of work in Old English; must have a general knowledge of English literature and English history; and must accomplish satisfactory work in research. Candidates for the Master's degree must have sufficient knowledge of French or German to make use of scholarly works in one of those languages, and candidates for the Doctor's degree must have a similar knowledge of both French and German, and a reading knowledge of Latin.

Introductory Course; English Poetry and Prose; Nineteenth-Century Prose; Advanced Composition; Teachers' Course; Play Writing; Nineteenth-Century Poetry; Greek and Latin Classics in Translation; Eighteenth-Century Poetry; Eighteenth-Century Prose; American Literature; Poetry and Versification.

Old English; Beowulf. Assistant Professor MONROE.  
 Early English Literary Types. Professor COOPER.  
 Chaucer and his Contemporaries. Professor STRUNK.  
 Shakespeare. Professor STRUNK.  
 Shakespeare. Professor ADAMS.

The English Drama to 1642. Professor ADAMS.  
 Dante in English. Professor COOPER.  
 Victorian Literature. Professor NORTHUP.  
 Methods and Materials in the Study of English. Professor COOPER.  
 Chaucer. Professor COOPER.  
 Dramatic Structure. Professor SAMPSON.  
 Non-dramatic Literature, 1500-1600. Professor ADAMS.  
 The Arthurian Legends. Professor NORTHUP.  
 Pastoral Poetry. Assistant Professor BROUGHTON.  
 Principles of Literary Criticism. Professor COOPER.  
 Relations of English and American Literature. Professor PRESCOTT.

In addition to directing research beyond the limits of the courses listed above, the members of the instructing staff will supervise original work, either in seminars or by individual conferences, in the fields here noted:

Wordsworth and his Contemporaries. Assistant Professor BROUGHTON.  
 Early Middle English; Layamon's Brut. Assistant Professor MONROE.  
 The English Language; selected topics. Assistant Professor MONROE.  
 Elizabethan Literature. Professor ADAMS.  
 Milton and Spenser. Professor STRUNK.  
 The Comparative Study of Literature. Professor COOPER.  
 Middle English Literature. Professor NORTHUP.  
 American Literature. Professor PRESCOTT.  
 English Philology. Professor STRUNK.  
 Theory of the Drama. Professor SAMPSON.  
 Poetry. Professor SAMPSON.

### PUBLIC SPEAKING

Professors: A. M. DRUMMOND; G. B. MUCHMORE; E. L. HUNT.

Instructors: H. CAPLAN; H. H. HUDSON; R. HANNAH.

Graduate students may choose Public Speaking as a minor or as a major subject for the Master's degree, or as a minor subject for the Doctorate. Studies may be undertaken in the principles of public speaking, in its psychology and pedagogy, in the literature and history of the subject, or in speech training.

Proficiency in English composition and in public speech will be presupposed. Graduate students should also have had training in psychology, literature, and history. Courses in logic and argumentation will prove helpful. Definite requirements for admission to graduate study on request.

Public Speaking (Elementary); Voice Training; Oral Reading; Argumentation.

Advanced Public Speaking. Professor DRUMMOND.

Seminary. Professor DRUMMOND and members of the staff.

**PHILOSOPHY AND PSYCHOLOGY**

The subjects of Philosophy and Psychology are grouped in The Susan Linn Sage School of Philosophy. This School owes its existence to the generosity of the late Henry W. Sage, who, in addition to endowing the Susan Linn Sage philosophical professorship, made a further gift of \$200,000, for the purpose of providing permanently at Cornell University for philosophical instruction and investigation of the most varied kind and of the highest order. The endowments of the School of Philosophy enable it to secure whatever material facilities are required for the successful prosecution of philosophical studies and research. The more important philosophical and psychological journals, American and foreign, are received by the Library, which is also well equipped with philosophical and psychological works, and is particularly rich in literature relating to Plato, Spinoza, and Kant.

The larger part of the work of the Sage School is adapted to the needs of graduates of this and other institutions who are preparing themselves to be teachers or investigators in philosophy and in allied fields of study. A student who has made a special study of philosophy during his junior and senior years may still take a graduate course of three years' work with history of philosophy, logic and metaphysics, ethics or psychology, as his major subject. For the encouragement of higher studies and research in every branch represented by the School of Philosophy, there have been established three fellowships of the annual value of \$400 each, and six scholarships of the annual value of \$200 each. Holders of fellowships and graduate scholarships are also exempt from the payment of tuition. Of these, one fellowship and one scholarship are regularly assigned to psychology. Applicants for fellowships and scholarships should therefore state definitely whether their major subject will be in one of the several branches of philosophy or in psychology.

The School is devoted to the free and unhampered investigation of truth in regard to all those questions of human inquiry which are embraced by logic, metaphysics, psychology, ethics, aesthetics, and the history and philosophy of religion. In the courses of instruction are represented the chief branches and problems of philosophy. Work devoted to the thesis for the doctorate is intended to secure the maximum of specialized training and the power of independent inquiry and statement of results. In all divisions of philosophy particular stress is laid upon the historical study of philosophical ideas as the best means of securing a comprehensive grasp of fundamental problems and values.

**Philosophy**

**Professors:** J. E. CREIGHTON, Logic and Metaphysics; FRANK THILLY, Philosophy; W. A. HAMMOND, Ancient and Medieval Philosophy and Aesthetics; ERNEST ALBEE, Philosophy.

**Instructor:** Dr. E. T. PAINE, Philosophy.

The philosophical seminary room in the University Library is provided with complete sets of the leading philosophical journals, lexicons, and other books of reference, and the more important works in the several branches of philosophy and psychology. The current numbers of the philosophical journals are also to

be found in the room. Liberal provision is made for the constant growth of this special library.

The Philosophical Review, established by the University, is a bi-monthly journal devoted to the interests of philosophy, embracing under that title logic, metaphysics, ethics, psychology, aesthetics, and philosophy of religion. Although supported by private endowment, it is not the organ of any institution or of any philosophical school, but by the terms of the subsidy is an absolutely free organ of contemporary philosophy. Graduate students assist by contributing summaries of periodical literature for publication in the Review, and are thus kept in close touch with the results of recent investigations in their several departments of work. In addition to this, graduate students have from time to time contributed original articles to the pages of the Review.

Under the title of Cornell Studies in Philosophy, a series of monograph studies is published from time to time as representative of the work done by graduate students in philosophy. These monographs are issued under the editorial supervision of the professors of philosophy, and consist mainly of studies undertaken originally as dissertations for the doctorate. The series furnishes also a channel for the publication of research other than that of the thesis. Twelve monographs have been issued in the series.

A full description of the courses given by the Sage School of Philosophy will be found in the Announcement of the College of Arts and Sciences. While any of these courses may be utilized by graduates, attendance at lectures is to be regarded only as an aid to the independent development on the part of the student of critical scholarship and methods of investigation.

Problems of Philosophy; Logic; Fine Arts; Ethics; Moral Ideas and Practice; Renaissance; Philosophical Ideas in Nineteenth Century Literature; Theory of Evolution; History and Philosophy of Religion.

History of Philosophy. Professor CREIGHTON.

Rapid Reading of German Philosophy. Professor HAMMOND.

History of Ancient and Medieval Philosophy. Professor HAMMOND.

Types of Metaphysical Theory. Professor CREIGHTON.

Philosophical Applications and Results. Professor CREIGHTON.

History of Ethics, Ancient, Medieval, and Renaissance. Professor HAMMOND.

History of Modern Ethics. Professor ALBEE.

Social and Political Ethics. Professor THILLY.

The Ethics of Utilitarianism. Professor THILLY.

Modern Idealistic Theories of Ethics. Professor THILLY.

The Republic of Plato, Greek text. Professor HAMMOND.

Aristotle's Ethics, Greek text. Professor HAMMOND.

Thomas Aquinas. Professor HAMMOND.

Empiricism and Rationalism in the Seventeenth and Eighteenth Centuries.  
Professor ALBEE.

The Critical Philosophy of Kant. Professor ALBEE.

Early Rationalism: Spinoza and Leibniz. Professor ALBEE.

German Pessimism, with special reference to Schopenhauer. Professor ALBEE.

Problems and Methods in Recent Philosophy. Professor ALBEE.



**Logical Theory:** A study of Bradley, Bosanquet, Dewey, and others. Professor ALBEE.

**Fundamental Ethical Concepts.** Professor THILLY.

**Seminary in Ethics.** Professor THILLY.

**Seminary in Logic and Metaphysics.** Professor CREIGHTON.

**Seminary in Ancient and Medieval Philosophy.** Professor HAMMOND.

**Seminary in Aesthetics.** Professor HAMMOND.

### Psychology

**Professors:** E. B. TITCHENER; H. P. WELD; K. M. DALLENBACH.

**Instructor:** L. B. HOISINGTON.

The research department of the psychological laboratory in Morrill Hall contains fifteen rooms, two of which are used as the private laboratories of the officers of instruction, one as a seminary room, and one as a workshop; the remainder are at the disposal of students for advanced work. The experimental rooms are furnished, as required, with air, gas, water, and the direct and alternating electric current; they are also connected by an elaborate wiring system, so that two or more rooms may be employed together in a single investigation. There are two dark chambers. The workshop is adequately equipped. The laboratory possesses standard instruments of precision for all the principal modes of experiment upon human consciousness, and is especially rich on the side of acoustics. Materials are available, or can be supplied, for the study of certain problems in comparative psychology. The equipment is undergoing continual improvement, and special apparatus required for research is at once constructed or procured. The results of investigations pursued in the laboratory are published in the American Journal of Psychology.

Graduate students further have the use of the unusually complete sets of demonstrational and teaching apparatus contained in the demonstrational laboratory (Goldwin Smith Hall) and the undergraduate laboratory (Morrill Hall).

**Elementary Psychology.** Professor TITCHENER, Assistant Professor DALLENBACH, and Dr. HOISINGTON.

**Experimental Psychology, Qualitative and Quantitative.** Professor WELD, Assistant Professor DALLENBACH, and Dr. HOISINGTON.

**Systematic Psychology: Sensation, Image.** Professor WELD.

**Systematic Psychology: Feeling, Attention, Action.** Professor WELD, Assistant Professor DALLENBACH, and Dr. HOISINGTON.

**Reading of German Psychology.** Assistant Professor DALLENBACH.

**Reading of French Psychology.** Dr. HOISINGTON.

**Apparatus and Methods: Technique of the Laboratory.** Assistant Professor DALLENBACH.

**Psychological Problems, Historical and Experimental.** Professor WELD, Assistant Professor DALLENBACH, and Dr. HOISINGTON.

**Research Laboratory.** Professor TITCHENER.

## EDUCATION

Professor: R. M. OGDEN.

Instructor: SETH WAKEMAN.

The educational museum contains collections illustrating the work done in various school grades, statistical charts, a full assortment of textbooks for American and German schools, including a relatively complete collection of the texts used for industrial training in the German continuation schools, an extensive high school and college exhibit of the raw materials of commerce, a kindergarten and a Montessori exhibit, and other appropriate material.

The educational laboratory has a collection of apparatus for demonstration, and of instruments of precision for research in connection with school hygiene, the experimental study of school children (with special reference to the conduct of physical and mental tests), and the psychological phases of education in general. This equipment is constantly being enlarged and apparatus needed for special investigations is at once procured.

Graduate students selecting education as their major subject will be expected to take from one-half to two-thirds of their work in the studies that are fundamental to an adequate mastery of educational theory and practice. These fall naturally into two groups, the philosophical and the social. The philosophical studies include psychology, ethics, and the history of philosophy; the social studies include political, social, and economic science. All graduate study in education presupposes familiarity with the history and principles of education and with educational psychology. Candidates for advanced degrees whose preparation in this respect is inadequate must make up this deficiency by taking the appropriate undergraduate courses.

Educational Psychology; Principles of Education; History of Education; Experimental Education; Mental Measurements.

Philosophy of Education. Professor OGDEN.

Experimental Investigation. Professor OGDEN and Mr. WAKEMAN.

Reading of German Educational Psychology. Professor OGDEN.

Aesthetic Education. Professor OGDEN.

Seminary in Education. Professor OGDEN.

## HISTORY AND POLITICAL SCIENCE

The subjects of history, government, and economics have been united since 1887 in the President White School of History and Political Science, which bears the name of the first president of the University in especial recognition of the gift of his valuable collection of historical literature to the University Library.

The aims of the President White School are threefold: first, the advancement of knowledge by investigation and publication in the fields of history, economics, politics, jurisprudence, and social science; second, the training of scholars and teachers in these departments of study; third, the training of men and women for the public service, for business, and for professions such as law, journalism, and philanthropy.

The School issues the Cornell Studies in History and Political Science, of which five volumes have appeared.

1. Money and Credit Instruments in their Relation to General Prices. By Edwin Walter Kemmerer, Ph.D., now Professor in Princeton University. First edition, 1907. Second edition, 1909.

2. Sargon of Assyria. By Albert Ten Eyck Olmstead, Ph.D., now Professor of History in the University of Illinois. 1908.

3. The Judicial Work of the Comptroller of the Treasury. By Willard E. Hotchkiss, Ph.D., now Director of the National Industrial Federation of Clothing Manufacturers. 1910.

4. Social Insurance: an Economic Analysis. By Robert Morse Woodbury, Ph.D., now Director of Statistical Research, Children's Bureau, U. S. Department of Labor. 1917.

5. The Liberal Republican Movement. By Earle Dudley Ross, Ph.D., now Professor of History in North Dakota Agricultural College. 1919.

### HISTORY

Professors: G. L. BURR, Medieval History; NATHANIEL SCHMIDT, Oriental History; C. H. HULL, American History; J. P. BRETZ, American History; CARL BECKER, Modern European History; W. L. WESTERMANN, Ancient History; WALLACE NOTESTEIN, English History.

A graduate student in history should have a sufficient knowledge of general history and of geography. He should be able to speak and write good English. He should have a reading knowledge of French, of German, and of any other language necessary for the thorough study of his special subject. For work in Medieval History he would much need a knowledge of Latin, and for Ancient History both Latin and Greek. It is highly desirable that he should have had the necessary linguistic training as an undergraduate; but deficiencies in this respect may sometimes be made up after entering upon graduate work.

The University Library contains some ninety or a hundred thousand volumes dealing with history. In large part these are to be found in the room known as the White Historical Library. Graduate students have immediate access to this rich group of books, which, with its many special collections, offers every facility for training in the methods of minute and exhaustive research. The historical seminary rooms in the library building are amply furnished with atlases, cyclopedias, dictionaries, bibliographies, and other useful works of reference, and afford easy access to the shelves of the Library proper.

It has been from the outset the policy of the University, while providing adequately for the symmetrical growth of the Library, to acquire the richer private collections of books which eminent scholars have through a lifetime of study built up as their tools of research. Thus, for the study of Oriental History, Cornell has been endowed with the EISENLOHR COLLECTION on the history of Egypt, with the WASON COLLECTION on the history and the civilization of China, and with that of President White on the history of Palestine. For the study of the Graeco-Roman world, it acquired that of Charles Anthon. For the Middle Ages, it has notable bodies of books on the birth of the Papal state, on the rise of the Carolingian empire, and, in general, on the relations of Church and State. For the

Renaissance, it can boast the unrivaled FISKE COLLECTIONS on Dante and Petrarch and the world of their time. For the age of the Reformation, for the history of superstition and persecution (notably for Inquisition and Index, for the story of witchcraft, for the beginnings of the sciences, for the rise of tolerance), it is equipped with the riches of the PRESIDENT WHITE LIBRARY; and for the study of the French Revolution that library has no equal on this side of the Atlantic, if anywhere outside of France. For the history of America, the University possesses the library of the historian Jared Sparks, with the MAY COLLECTION on American slavery and the SCAIFE COLLECTION on the Civil War. Professor Goldwin Smith enriched it with his working library of English history; it obtained that of Professor Tuttle on Prussia; from Professor Fiske came one singularly complete on Iceland. In a multitude of narrower fields it has been found possible to gather for the special student materials for exhaustive research. Many of these collections are endowed with special funds for their increase; and all have been steadily built up with an eye to the needs of the mature student of history.

Two fellowships and a scholarship are annually awarded to graduate students of history. The President White Fellowship in Modern European History has a value of \$500. It may be granted as a traveling fellowship. The Fellowship in American History amounts to \$400. The Graduate Scholarship in History amounts to \$200. Holders of fellowships and graduate scholarships are exempt from the payment of tuition. There are six assistantships in history, which are filled preferably by the appointment of graduate students.

The teachers and graduate students of history have formed a History Club, which meets once a month for the reading and discussion of papers on historical topics and for social intercourse.

Greek History; Roman History.

The Middle Ages (300-1300 A. D.).

Renaissance and Reformation (1300-1600).

Modern European History (1600-1921, with emphasis on the last century, especially since 1870).

English History (1763-1921).

American History (to 1815; 1815-1875; since 1875).

Economic History of the United States (1600-1900).

History of Asia; History of Africa. Professor SCHMIDT. (See under Semitics).

Greek Civilization. Professor WESTERMANN.

Hellenistic-Roman Civilization. Professor WESTERMANN.

Greek Political Institutions. Professor WESTERMANN.

Roman Political Institutions. Professor WESTERMANN.

Roman Empire of the East (Byzantine Empire). Professor WESTERMANN.

Economic History of Greece and Rome. Professor WESTERMANN.

Seminary in the Ptolemaic and Roman Administration of Egypt. Professor WESTERMANN.

Seminary in Medieval History (Historical Method). Professor BURR.

Canon Law. Professor BURR.

The Rise of Tolerance. Professor BURR.

The French Revolution and Napoleon. Professor BECKER.



Seminary in Modern European History. Professor BECKER. During 1921-1922 the seminary will be devoted either to the intellectual movement of the eighteenth century or to the French Revolution.

Anglo-German Relations, 1900-1914. Professor NOTESTEIN.

England, 1640-1660. Professor NOTESTEIN.

Growth of Parliament, 1295-1558. Professor NOTESTEIN.

Growth of Parliament, 1558-1689. Professor NOTESTEIN.

Constitutional History of the Colonies and States to 1780. Professor HULL.

Foreign Relations of the United States in the First Century. Professor HULL.

Constitutional History of the United States since 1860. Professor BRETZ.

The Settlement of the Middle West. Professor BRETZ.

History of the United States, 1860-1865. Professor BRETZ.

Seminary in American History. Professor HULL.

The History of Civilization. THE FACULTY OF HISTORY.

The Sciences Auxiliary to History (their aims, methods, literatures, and use to history). Professor BURR.

Historical Geography. Professor BURR.

Palaeography and Diplomatics. Professor BURR.

Historical Method (the nature, scope, materials, and method of history). Professor BURR.

The Teaching of History. Professor BURR, with aid from his colleagues.

Introduction to the Literature of History (a general survey, period by period, of the sources and literature of history). Professors SCHMIDT, WESTERMANN, BURR, BECKER, HULL, BRETZ, and NOTESTEIN.

#### POLITICAL SCIENCE

Professors: W. F. WILLCOX, Economics and Statistics; S. P. ORTH, Politics; H. J. DAVENPORT, Economics; G. N. LAUMAN, Rural Economy; DONALD ENGLISH, Economics and Accounting; J. H. ROGERS, Economics and Finance; R. S. SABY, Politics; S. H. SLICHTER, Economics.

Instructors: K. W. BIGELOW; J. D. BLANCHARD; J. R. HILGERT; E. R. SIKES; W. H. WALTER; C. E. WARNE.

A student in economics should have as a preparation for graduate study at least the equivalent of elementary courses in economics, economic history, politics, and social science. If he has not this preparation, he should take such elementary courses as early as possible; he will not ordinarily be allowed to present this preliminary work as partial fulfilment of the requirement for a major or minor in any branch of political science.

The work in political science in the President White School of History and Political Science falls into five divisions: economic theory, finance, social science and statistics, accounting, politics. These divisions aim to bring their work into close relationship with social, political, and business life. The members of the Faculty seek to keep in touch with the practical as well as with the purely scientific aspects of the problems treated, and have among their interests the preparation of students for positions in business and in public service.

In economic theory, a graduate course is offered in value and distribution, which is designed to familiarize the student with the main currents of contem-

porary economic thought. For undergraduates and graduates, courses are offered covering the principles of economics and the general theory of taxation.

In finance, a research course is offered to graduate students which is designed to afford training in the appropriate methods of investigation and to give familiarity with the fundamental sources of information. Other courses in this field open to graduates cover the more important economic aspects of both public and private finance.

In social science and statistics, advanced work is offered mainly in statistics, but to some degree also in the less definite field of social science. The statistical method has been found of special service both in developing a scientific and judicial attitude and in bringing out many facts about social life not discoverable in any other way.

Advanced work in accounting is offered in the field of accounting theory, and students are offered an opportunity to investigate the practical accounting problems of a particular business.

The courses in politics are designed to familiarize the student with the structure and functions of government—state, national, and municipal. In the advanced courses, special problems are studied. In the course in research each student is allowed to follow up an investigation of the sources of some particular subject. Students desiring to specialize in Politics should take, as a foundation, the courses on American Political Institutions and Comparative Politics. Courses on Business Law and on Government Control of Industry cannot be regarded as constituting graduate work.

This group uses two laboratories and several class rooms in proximity to each other and to the four division offices and one general office, an arrangement which has greatly facilitated intercourse between teachers and graduate students as well as among graduate students themselves. In the political science seminary room at the University Library, and in the various offices and laboratories occupied by these departments, numerous publications in politics and in economics are accessible to advanced students. The laboratories for classes in statistics and finance are supplied with standard and current books dealing with these subjects and with various mechanical devices for simple statistical processes and for securing a graphic and effective presentation of results.

In the closely related subject of rural economy or agricultural economics, courses are offered dealing with the general economic and social problems of the open country arising from the growing complexity and intensity of agriculture and its relation with commerce, manufacturing, and transportation.

Several teaching assistantships, yielding \$500; three fellowships, two yielding \$400 and tuition, and one yielding \$500 and tuition, and several assistantships, each yielding \$250, are filled each spring.

#### **A. Economics.**

Elementary Social Science. Professor WILLCOX.

Principles of Accounting. Professor ENGLISH.

Cost Accounting. Professor ENGLISH.

Accounting Problems. Professor ENGLISH.

Demography or Population Statistics. Professor WILLCOX.

Economic and Industrial Statistics. Professor WILLCOX.

Corporation Finance. Assistant Professor ROGERS.  
 Investment and Speculation. Assistant Professor ROGERS.  
 Money and Banking. Assistant Professor ROGERS.  
 Trade Unionism and Related Problems. Assistant Professor SLICHTER.  
 The State in Relation to Labor. Assistant Professor SLICHTER.  
 Principles of Economics. Professor DAVENPORT.  
 Public Revenues. Professor DAVENPORT.  
 Value and Distribution. Professor DAVENPORT.  
 Research in Statistics. Professor WILLCOX.  
 Research in Finance. Assistant Professor ROGERS.  
 Research in Accounting. Professor ENGLISH.  
 Rural Economy. (See Agricultural Economics and Farm Management pp. 58, 60.)

**B. Government and Public Law.**

Political Institutions. Professor ORTH.  
 Comparative Politics. Professor ORTH.  
 Municipal Administration. Assistant Professor SABY.  
 Municipal Problems. Assistant Professor SABY.  
 State Administration. Professor ORTH.  
 The American Party System. Professor ORTH.  
 Constitutional Government. Professor ORTH.  
 History of Political Thought. Assistant Professor SABY.  
 Modern Political Thought. Assistant Professor SABY.  
 The Nature of the State. Assistant Professor SABY.  
 International Law and Diplomacy. Professor ORTH.  
 Elements of Business Law. Professor ORTH.  
 Government Control of Industry. Professor ORTH.  
 Research in Politics. Professor ORTH.  
 Seminary in Political Science and Public Law. Professor ORTH.

**MATHEMATICS**

Professors: J. H. TANNER; J. I. HUTCHINSON; VIRGIL SNYDER; F. R. SHARPE;  
 W. B. CARVER; ARTHUR RANUM; D. C. GILLESPIE; W. A. HURWITZ; C. F.  
 CRAIG; F. W. OWENS.

Instructors: F. W. REED; A. D. CAMPBELL; H. S. VANDIVER; G. M. ROBISON;  
 HELEN B. OWENS; W. L. G. WILLIAMS; H. M. MORSE; D. S. MORSE;  
 P. A. FRALEIGH; H. PORITSKY; H. M. LUFKIN.

The graduate work provides instruction in the principal branches of mathematics and furnishes preparation and material for independent investigation. Only a portion of the whole field can be covered by the courses given in a single year. The courses are changed, therefore, from year to year in order to meet the needs of the students.

In addition to the regular instruction, individual guidance and advice are offered to any student who wishes to follow a particular line of inquiry.

The equipment consists of a collection of about three hundred surfaces, including the various forms of the cyclides, the Kummer surface, the surface of centers, and minimum surfaces; plaster models illustrating positive, negative, and parabolic curvature, and constant measure of curvature; plaster models illustrating the theory of functions, among them models of simply and multiply connected surfaces, and of several forms of Riemann's surfaces, and models representing the real parts of algebraic, exponential, logarithmic, and elliptic functions; wooden and glass models of crystals and polyhedra; wire and thread models of twisted curves and ruled surfaces, and skeleton frames for minimum surfaces.

The University Library has a large collection of books on pure and applied mathematics, including collected works of mathematicians, complete sets of all the important mathematical journals, transactions and other publications of scientific societies, and doctoral theses from the leading American and European universities.

The Oliver Mathematical Club, composed of teachers and advanced students, meets weekly, and has for its object the systematic presentation by the members of some specified mathematical theory of recent development, and of reports on noteworthy articles in current journals and on results of special reading and investigation.

Solid Geometry; Advanced Algebra; Trigonometry; Analytic Geometry; Differential Calculus; Integral Calculus.

Mathematics of Finance. Professor TANNER.  
 Solid Analytic Geometry. Professor SNYDER.  
 Hydrodynamics and Elasticity. Professor SHARPE.  
 Modern Higher Algebra. Professor CARVER.  
 Non-euclidian Geometry. Professor RANUM.  
 Synopsis of Higher Mathematics. Professor RANUM.  
 Advanced Calculus. Professor GILLESPIE.  
 Integral Equations. Professor HURWITZ.  
 Functions of a Complex Variable. Professor CRAIG.  
 Probabilities. Professor OWENS.  
 Dynamics. Dr. REED.  
 Advanced Analytic Geometry. Dr. WILLIAMS.  
 Elliptic Functions. Dr. H. M. MORSE.  
 Projective Geometry. Dr. H. B. OWENS.  
 Groups. Mr. VANDIVER.  
 Elementary Differential Equations. Dr. ROBISON.

Several other courses may be offered by members of the instructing staff.

Students who take mathematics as a major subject for an advanced degree must have completed previously the equivalent of the elementary course in analytic geometry and calculus, and some further study in at least one somewhat more advanced subject, as for example, differential equations, advanced calculus, modern algebra, or projective or analytic geometry.



## PHYSICS

Professors Emeritus: GEORGE S. MOLER; EDWARD L. NICHOLS.

Professors: ERNEST MERRITT; FREDERICK BEDELL; C. C. BIDWELL; R. C. GIBBS; H. E. HOWE; E. H. KENNARD; C. C. MURDOCK; F. K. RICHTMYER; J. S. SHEARER; J. E. TREVOR.

Instructors: J. A. BECKER; L. J. BOARDMAN; Y. R. CHAO; J. R. COLLINS; C. L. COTTRELL; L. F. CURTISS; R. M. FISHER; R. M. HOLMES; A. I. HOUSMAN; J. M. HYATT; ALICE ROTHWELL HYATT; C. B. JOLLIFFE; S. S. MACKEOWN; F. A. MAY; C. MOON; H. MOTT-SMITH; P. A. NORTHROP; J. O. PERRINE; W. M. PIERCE; F. W. REYNOLDS; D. E. RICHMOND; M. SCOTT; E. P. T. TYNDALL; D. T. WILBUR; I. WOLFF.

Opportunities are offered for study and investigation in the various branches of the science, both theoretical and experimental. Some of these opportunities are indicated in the following statement; more complete information can be obtained by those interested through correspondence addressed to the Department of Physics or to individual members of the staff.

The facilities for radiometric and spectrophotometric work, for the investigation of the properties of matter throughout a very wide range of temperatures, for the study of Roentgen rays and allied phenomena, in electricity, especially for the study of alternating current phenomena, in the application of photographic methods to problems in experimental physics, etc., are exceptionally good.

About forty rooms in Rockefeller Hall are set aside for advanced workers. Research is organized as a distinct division with its own equipment, stock, and apparatus room, well equipped workshop for the use of graduate students, complete appliances for the production and handling of gases, including generators, low and high pressure storage tanks, compressors, power driven vacuum pumps, machinery for the liquefaction of air and other gases, apparatus for the production of X-Rays, a refrigerating plant, a dynamo laboratory fully equipped with various sorts of direct and alternating current apparatus, etc. An instrument maker's shop is devoted to the construction and repair of apparatus. The services of two expert mechanics are always available in connection with this work.

Members of the staff will be especially interested in directing the research of graduate students in the fields indicated: Professor Bedell, in applied electricity, theoretical and experimental, particularly in alternating-current phenomena, and in aerodynamics; Professor Bidwell, in high and low temperature measurements; Professor Gibbs, in spectroscopy and luminescence; Professor Howe, in optics; Professor Kennard, in theoretical physics and radiation; Professor Merritt, in experimental physics, particularly in electricity and magnetism and problems connected with luminescence; Professor Murdock, in electrolytic conduction and polarization, particularly in photo-active cells; Professor Richtmyer, in photometry, illumination, and photo-electricity; Professor Shearer, in X-rays and radioactivity; Professor Trevor, in the theory of thermodynamics.

Several members of the staff will be in residence during the summer for the purpose of consultation with investigators desiring to avail themselves of the facilities of the laboratory.

Students desiring to undertake graduate work as candidates for a degree should have completed at least two years of undergraduate work in physics, i. e.,

the equivalent of course 12 (Physics) and its prerequisites. See the Announcement of the College of Arts and Sciences, where also is given further information in regard to the advanced courses listed below.

### Introductory Courses

First Year Physics (experimental lectures, class work, laboratory); Second Year Physics (class work, laboratory); Electrical Measurements; Photometry and Illumination; Practical Photography; X-Ray Photography; Physics for Teachers.

### Advanced Courses

Heat. Professor BIDWELL.  
 [Light. Professor HOWE.]  
 Electricity and Magnetism. Professor MURDOCK.  
 [Properties of Matter. Professor MURDOCK.]  
 [Wave Motion and Sound. Professor MURDOCK.]  
 Advanced Laboratory Practice. Professor MURDOCK.  
 Theory of Measurements. Professor MURDOCK.  
 Photometry and Spectrophotometry. Professor RICHTMYER.  
 High Temperature Measurements. Professor BIDWELL.  
 Alternating Currents. Professor BEDELL.  
 Electrical Laboratory. Professor BEDELL.  
 Aerodynamics and the Mechanics of Flight. Professor BEDELL.  
 Introduction to Modern Physical Theories. Professor RICHTMYER.  
 [Conduction in Gases. Professor MERRITT.]  
 Electric Waves and Oscillations. Professor MERRITT.  
 Spectroscopy and Luminescence. Professor GIBBS.  
 X-Ray Photography. Professor SHEARER.  
 Advanced X-Ray Laboratory. Professor SHEARER.  
 Radioactivity and Allied Phenomena. Professor SHEARER.  
 Physical Optics. Professor HOWE.  
 Physics Seminary. Professor MERRITT.  
 Junior Physics Seminary. Professor RICHTMYER.  
 Theoretical Physics, Mechanics and Thermodynamics. Professor KENNARD.  
 [Theoretical Physics, Electricity and Magnetism. Professor KENNARD.]  
 Electron Theory. Professor KENNARD.  
 Thermodynamics. Professor TREVOR.

Other courses may be offered according to circumstances. Courses in brackets will probably not be given in 1921-1922.

### CHEMISTRY

Professors: L. M. DENNIS, Inorganic Chemistry; W. R. ORNDORFF, Organic and Physiological Chemistry; W. D. BANCROFT, Physical Chemistry; E. M. CHAMOT, Chemical Microscopy and Sanitary Chemistry; G. W. CAVANAUGH, Agricultural Chemistry; A. W. BROWNE, Inorganic and Analytical Chemistry; F. H. RHODES, Industrial Chemistry; T. R. BRIGGS, Physical Chemistry; F. E. RICE, Agricultural Chemistry.

Instructors: A. J. RIDER; M. NICHOLS; F. R. GEORGIA; J. PAPISH; A. E. MCKINNEY; G. H. BRANDES; R. T. K. CORNWELL.

A graduate student who desires to take either a major or a minor subject in chemistry may select any one of the following eight branches: inorganic chemistry, analytical chemistry, organic chemistry, physical chemistry, sanitary chemistry, chemical microscopy, industrial chemistry, agricultural chemistry. Under the present procedure, both the major subject and the one minor subject required for the degree of Master of Arts, and the major subject and the two minor subjects required for the degree of Doctor of Philosophy may be selected from the eight divisions mentioned above; but it is desirable that candidates for the degree of Doctor of Philosophy select at least one minor subject outside of chemistry.

A graduate student who desires to take a minor subject in chemistry with some subject other than chemistry as the major subject, will be required to offer introductory inorganic chemistry and elementary qualitative and quantitative analysis as preliminary to his graduate work. The work upon his minor subject in chemistry may be taken in any branch of the subject that he is qualified to pursue, and may comprise advanced courses selected from the subjoined list, with the approval of his special committee.

Candidates for the degree of Master of Arts, or that of Doctor of Philosophy, with the major subject in chemistry will be expected to have a reading knowledge of French and German, and will be required to offer as preliminary to their graduate work in chemistry the following subjects: introductory inorganic chemistry, elementary qualitative and quantitative analysis, advanced quantitative analysis, introductory chemical spectroscopy, gas analysis, organic chemistry, chemical microscopy, and physical chemistry. Courses in these subjects, if taken in another university, will be accepted if they are substantially equivalent to the courses offered at Cornell. Graduate students entering from other universities may take during their residence for the advanced degree such of the above courses as they have not already pursued. If a graduate student lacks at entrance several of these preliminary courses, more than the minimum period of residence may be necessary. More advanced courses may be elected from the appended list with the approval of a candidate's special committee.

The equipment of the Department of Chemistry for the instruction of the graduate as well as the undergraduate student is unusually complete and there are excellent opportunities for research in each of the various lines of instruction.

### **Inorganic Chemistry**

Introductory Inorganic Chemistry. Qualitative and Quantitative Analysis. Advanced Inorganic Chemistry. Lectures and laboratory. Professors DENNIS and BROWNE.

Selected Topics in Advanced Inorganic Chemistry. Lectures. Professor BROWNE and Mr. MCKINNEY.

### **Analytical Chemistry**

Advanced Quantitative Analysis. Lectures and laboratory. Professor BROWNE and Mr. NICHOLS.

Electrochemical Analysis. Laboratory. Professor BROWNE and Mr. NICHOLS.

Introductory Chemical Spectroscopy. Lectures and Laboratory. Professor CHAMOT and Mr. PAPISH.

Advanced Chemical Spectroscopy. Laboratory. Professor CHAMOT and Mr. PAPISH.

Chemical Polarimetry and Refractometry. Laboratory. Professor CHAMOT and Mr. PAPISH.

Spectrographic Methods. Laboratory. Professor BROWNE and Mr. PAPISH.

Gas Analysis. Lectures and laboratory. Professor BROWNE and Mr. NICHOLS.

Advanced Gas Analysis. Laboratory. Professor BROWNE and Mr. NICHOLS.

### Organic Chemistry

Organic Chemistry. Lectures and laboratory. Professor ORNDORFF and Mr. CORNWELL.

Special Chapters in Organic Chemistry. Lectures. Professor ORNDORFF.

Advanced Organic Chemistry. Laboratory. Professor ORNDORFF and Mr. CORNWELL.

The Coal Tar Dyestuffs. Lectures and laboratory. Professor ORNDORFF and Mr. CORNWELL.

Stereochemistry. Lectures. Professor ORNDORFF.

Organic Analysis. Laboratory. Professor ORNDORFF and Mr. CORNWELL.

### Physical Chemistry

Physical Chemistry. Lectures and laboratory. Assistant Professor BRIGGS.

Advanced Physical Chemistry. Lectures. Professor BANCROFT.

Applied Colloid Chemistry. Lectures. Professor BANCROFT.

Theoretical Electrochemistry. Lectures. Professor BANCROFT.

Applied Electrochemistry. Lectures and laboratory. Assistant Professor BRIGGS.

Advanced Physical Chemistry. Laboratory. Professor BANCROFT and Assistant Professor BRIGGS.

Advanced Electrochemistry. Laboratory. Professor BANCROFT and Assistant Professor BRIGGS.

### Sanitary Chemistry

Sanitary Chemistry. Lectures and laboratory. Professor CHAMOT and Mr. GEORGIA.

Advanced Sanitary Chemistry. Lectures and laboratory. Professor CHAMOT and Mr. GEORGIA.

Special Topics in Sanitary Chemistry. Lectures. Professor CHAMOT and Mr. GEORGIA.

Chemistry of Foods and Food Products. Lectures. Professor CAVANAUGH.

### Chemical Microscopy

Chemical Microscopy. Lectures, laboratory, and demonstrations. Professor CHAMOT.

Advanced Chemical Microscopy. Laboratory. Professor CHAMOT.

Microscopy of Commercial Alloys. Laboratory. Professor CHAMOT.

Microscopy of Foods and Beverages. Laboratory. Professor CHAMOT.

### Industrial Chemistry

Industrial Chemistry. Lectures. Professor RHODES.

Advanced Industrial Chemistry. Lectures and Laboratory. Professor RHODES.



### Agricultural Chemistry

**Agricultural Chemistry.** General elementary course. Lectures, recitations, and laboratory. Professor CAVANAUGH, and Assistant Professor RICE.

**Chemistry of Fertilizers and Insecticides.** Lectures. Professor CAVANAUGH.

**Chemistry of Insecticides and Fungicides, Advanced Course.** Professor CAVANAUGH.

For other courses in Agricultural Chemistry see the Announcement of the College of Agriculture.

### GEOLOGY

Under the general title of geology are included dynamic geology, physical geography, mineralogy, crystallography, petrography, paleontology and stratigraphic geology, economic geology.

**Professors:** H. RIES, Dynamic and Economic Geology; G. D. HARRIS, Paleontology and Stratigraphic Geology; A.C. GILL, Mineralogy and Petrography; O. D. VON ENGELN, Physical Geography.

**Instructors:** W. C. BOWEN; D. D. SMYTHE; H. F. VIEWEG; F. A. CARLSON; O. P. BELL.

**General statement.** Graduate work in Geology may include in addition to work done in Ithaca, the opportunity of spending part of the time in investigation under approved direction in the field away from Ithaca.

The University Library has a most extensive collection of private publications, magazines, and geological society transactions, as well as files of North American, European, and other Geological Survey reports. In the Geological Department there is the entire library of the late Professor H. S. Williams, which is especially rich in reprints.

Special rooms are also available for graduate students for carrying on research work.

The department is provided with apparatus for different kinds of photographic work, and for polishing and sectioning ores, minerals, and rocks.

A seismograph station is located in McGraw Hall.

**Dynamic Geology.** No special graduate courses are offered in this branch, advanced work either in the field or laboratory being adjusted to the needs of the individual student. One taking a major in this branch of geology, should first have had at least elementary work in the other branches represented in the department.

**Physical Geography.** The region around Ithaca affords exceptionally excellent and varied illustrations of physiography and glaciology. For many years the teachers and advanced students of physical geography have been engaged in an investigation of the local field problems, and there is further opportunity of this kind. There are also excellent facilities for indoor work. The main laboratory is well equipped with topographic maps and photographs; the collection of relief models is notably complete, and there is an experimental laboratory with apparatus and facilities for carrying on a variety of experiments in the development of land forms, etc.

For admission to the advanced courses, it is required that the student have a working knowledge of the fundamental principles of the subject and have completed some reading other than textbooks. The advanced courses are intended to contribute to the training of students for positions in the better grade of secondary and normal schools, in colleges and universities, in the national geological survey, in exploring expeditions, and to afford preparation for research.

A candidate for an advanced degree whose major subject is in physical geography should have completed, during his undergraduate training, elementary university study in physics (including an advanced course in heat), chemistry, mathematics, and economics, in addition to introductory courses in physical geography and geology.

**Mineralogy, Crystallography, and Petrography.** The laboratory equipment is relatively good as regards petrographic microscopes, apparatus for chemical and physical investigations of rocks, and apparatus for special crystallographic determinations. There are also collections of rocks and study collections of minerals. The largest of the latter include the Benjamin Silliman, jr., collection.

Special graduate courses in this division are not offered, but advanced work is adapted to the needs of the individual. Two of the less advanced courses are, however, so dependent on a rather advanced knowledge of physics or of chemistry, or of both, that they are to be considered as requiring the maturity of graduates, although open also to undergraduates with sufficient preparation. These are the courses in optical determination of minerals and petrography. For graduate work in these subjects a student should have chemistry, including quantitative analysis, and a good knowledge of general physics. For petrography he should have also not less than a year of general geology.

**Paleontology and Stratigraphic Geology.** The university is so located that excellent exposures of Devonian formations are at its very door, and the typical sections of New York State, which are of fundamental importance in American Paleozoic geology, are within short excursion range. The most important of these are the Rochester and Niagara gorges, Trenton Falls, and the Helderberg escarpments, the Chemung Valley, and the coal fields in northern Pennsylvania. Summer field work has been carried on by boat over a still greater range, extending to Plattsburg on the north and to the Carolinas on the south, giving the student at small cost a chance to study a large portion of the geological column at first hand.

Facilities for those prepared to engage in research in paleontology and stratigraphic geology are furnished by summer cruises into the Tertiary areas of the southern states; eleven season's work in Louisiana, together with continuous work in oil investigations, two seasons in Arkansas, two in Texas, one in Europe; the results of numerous exchanges; the Newcomb collection (10,000 species) of recent shells; and the exceptional wealth of conchological literature in the geological and the general library. The extensive collections of southern Eocene material now being worked over, affords graduates specializing in Paleontology abundant material for research problems. *The Bulletin of American Paleontology* and *Palaeontographica Americana*, the only paleontological journals in the country, are published in the department.

**Economic Geology.** The work in economic geology is designed to familiarize the student with the origin, occurrence, and distribution of the mineral products

of economic value, and also with the practical application of geological principles. The laboratory contains an excellent study collection of economic materials from the United States, Canada, Mexico, and Europe, including ores, fuels, clays, abrasives, building stones, etc., most of these representing suites of material collected by members of the staff of instruction on geological trips. This collection is supplemented by maps and models.

In addition to the collections, the economic geology laboratory has facilities for general work and research on economic materials; the equipment for metallographic work on ores and for clay investigation is excellent.

The work of graduate instruction consists in part of lectures and in part of special work arranged to suit the needs of the individual student. Students who are registered for a major subject in economic geology are expected to engage in research, which should preferably be based on field work.

Excursions may readily be taken to the anthracite region of Pennsylvania to the iron, slate, cement, and talc region near Easton, Pa.; to the magnetite mines of the Adirondacks, etc. Field trips of greater or less length are taken to some of these localities every year.

Elementary Geology; Elementary Physical Geography; Geography of North America; Geography of Europe; Elementary Mineralogy; General Lithology; Crystallography; Blowpipe Determination of Minerals; Historic Geology; Economic Geology.

Glaciers and Glaciation. Assistant Professor VON ENGELN and Mr. CARLSON.  
Seminary in Physiography. Assistant Professor VON ENGELN.

Advanced Physiography, experimental and research. Assistant Professor VON ENGELN.

Mineralogy. Professor GILL.

Crystal Measurement and Drawing. Professor GILL.

Optical Determination of Minerals. Professor GILL.

Petrography. Professor GILL.

Seminary in Mineralogy and Petrography. Professor GILL.

Advanced or Special Work in Mineralogy and Petrography. Professor GILL.

Stratigraphic Geology. Professor HARRIS.

Paleontology. Professor HARRIS.

Research and Conference. Professor HARRIS.

General Economic Geology. Professor RIES.

Clay Investigation. Professor RIES.

Advanced Economic Geology. Professor RIES.

Economic Geology Seminary. Professor RIES.

## METEOROLOGY

Professor: W. M. WILSON.

Instructor: R. A. MORDOFF.

The weather and climatic factors, in their relation to crop distribution and production and to engineering, transportation, economic and social problems, are suitable subjects for graduate study.

The library of the Weather Bureau observatory, which is located in Roberts Hall, contains the meteorological data for such correlation studies. In addition, the library of the U. S. Weather Bureau at Washington, D. C., may be drawn upon for works of reference under proper restrictions.

A graduate student in meteorology should have completed the elementary courses in meteorology and climatology, physics, mathematics, geology, and preferably elementary statistics.

## BOTANY

(In the College of Arts and Sciences)

Professors: W. W. ROWLEE, ———.

The laboratories for advanced work and research are well equipped with apparatus and materials such as microscopes, microtomes, ovens, sterilizers, thermostats, water baths, cameras for photographic and photomicrographic work, culture rooms, electric lanterns, etc. The laboratories are directly connected with well-stocked greenhouses. These contain a large assortment of exotic plants, which afford material for illustration and comparison, as well as material for investigation. The greenhouses also afford space for experimental work in plant physiology and morphology, and for the growing of plants under observation. There are excellent facilities for field work in the vicinity of the University.

The University Library contains the more important periodicals and complete sets of journals relating to botanical science, and a large collection of special works devoted to the various subdivisions of the science, as morphology, embryology, histology, physiology, mycology, and the different systematic subdivisions. The works most frequently required for reference are kept in the departmental library.

The botanical seminars offer opportunity for keeping in touch with the current literature of the subject, and of dealing with the theoretical and practical aspects of the various problems under investigation.

As a prerequisite for graduate work in botany, either as a major or as a minor subject, the student should have a thorough knowledge of the fundamental principles of the science. In addition, some prerequisite or supplementary advanced work in morphology, organography, histology, and taxonomy (according to the nature of the subject chosen by the candidate) will be required. When the candidate has not had the desired advanced work, this may be taken either as preliminary to the work of his special investigation, or carried on at the same time as the latter, by registering in such of these courses as the special committee may determine.

General Comparative Morphology of Plants; Elementary Plant Physiology; Special Morphology; Taxonomy and Ecology of the Higher Plants; Geographical Botany; Organography and Identification of the Higher Plants; Taxonomy and Phylogeny of Angiosperms; Plant Cytology; Comparative Histology of Plants; Dendrology; Xylology; Comparative Morphology and Embryology; Mycology; Taxonomy of the Pteridophytes, Bryophytes, and Algae; Research in Morphology and Embryology; General Taxonomic Survey of the Fungi.

Research in Comparative Morphology, Embryology, and Experimental Morphology. Professor ———.



Research in Taxonomy and Phylogeny of the Angiosperms. Professor ROWLEE.

Research in Comparative Histology and Cytology. Professor ROWLEE.  
Seminary. Professor ROWLEE.

## BOTANY AND PLANT PHYSIOLOGY

(In the College of Agriculture)

Professors: K. M. WIEGAND; LEWIS KNUDSON; DONALD REDDICK; A. J. EAMES; L. W. SHARP; J. R. SCHRAMM; O. F. CURTIS.

Instructors: F. B. WANN; J. M. BRANNON; R. S. NANZ; L. F. RANDOLPH; W. C. MUENSCHER; J. J. GRIMM; E. I. FERNALD; A. L. GRANT.

The laboratories of this department are located in Stone Hall, one of the buildings of the College of Agriculture. Those devoted to general botany are supplied with microscopes, herbarium and preserved material, microtomes, paraffin baths, and other apparatus and material suitable for carrying on research work in taxonomic botany of the higher plants, and in plant histology, cytology and comparative morphology. In connection with research work in general botany, the very rich flora of Ithaca and vicinity makes the location a particularly desirable one. Gardens and greenhouses are also available for the growing of experimental material. The work in plant physiology is conducted in laboratories equipped with special reference to the demands of advanced instruction and research. Supplementary laboratory space is provided in two headhouses and two greenhouses of twenty-five by seventy-five feet each, these especially giving additional accommodations for the experimental work.

The class work in plant physiology is done in large, well-lighted laboratories provided with the necessary facilities for the study of the microscopic, the chemical and the physical aspects of the subject. The necessary microscopic outfits, lockers, and apparatus required in general physiology are available. Accommodations are made for thirty students in a section.

In a corresponding laboratory excellent facilities and equipment are provided for research in plant physiology. The department possesses seven incubators, drying ovens and paraffin oven; all of these are electrically heated and equipped for temperature control. Recording hygrometers and thermometers, balances, microtomes, photomicrographic apparatus, and a considerable number of other important large pieces of apparatus are included. There is also available a plentiful supply of all small apparatus which may be necessary.

The University Library is well equipped with special works and periodicals dealing with all phases of botanical science. A department library in which are kept books that are in frequent use has been established in connection with the laboratories.

A seminary in general botany, histology, cytology, comparative morphology, and taxonomy is conducted in which recent literature and special phases of botanical science are taken up for special discussion. The purpose of this seminary is not only to keep abreast of the literature of the subject, but also to furnish to the student an opportunity for the discussion of special phases of his own research. All graduate students except those in plant physiology are required to take part in this seminary.

A corresponding seminary in plant physiology offers to graduate students an opportunity to become familiar with current work in plant physiology and to consider the relations of this work to agricultural practices. At these meetings there are also held general conferences and discussions of opinions or methods not conveniently or appropriately dealt with in the general courses. All graduate students in plant physiology are required to take part in the work of this seminary, and to gain experience in presenting the results of their own research, or in developing opinions respecting the work of others.

As a prerequisite for work in general botany, histology, cytology, and comparative morphology, the student will be expected to have a knowledge of the fundamental features of botanical science. A student whose major subject is in this field will be expected to have had advanced courses in general botany, plant histology, cytology, and comparative morphology, depending upon the special field in which his work lies. If the advanced courses have not already been taken by a student who elects a minor in this department, he will be expected to take these during his work, and they may count in part toward the work which he offers for his degree.

In order to pursue graduate work in plant physiology or pathology, students must have had good scientific preparation. Special training in general biology, botany, and chemistry is essential. In no case, however, may a graduate student enter upon topical work or research without the equivalent of twelve hours of advanced work in courses in the subject. Special training in certain aspects of horticultural or agronomic work is also recognized as satisfying a general standard of scientific preparation.

General Elementary Botany; Forest Botany; Grasses; Weeds and Weed Seeds; General Plant Physiology.

Histology. Professor EAMES.

Cytology. Assistant Professor SHARP.

Comparative Morphology of Bryophytes, Pteridophytes and Spermatophytes. Assistant Professor SHARP.

Morphology of the Algae. Professor SCHRAMM.

Research in General Botany, Taxonomy and Physiology of the Algae, Histology, Cytology. Professors WIEGAND, SCHRAMM, and EAMES, and Assistant Professor SHARP.

Seminary in General Botany, Histology, Cytology, and Taxonomy. Professors WIEGAND, SCHRAMM, REDDICK, and EAMES, and Assistant Professor SHARP.

Physiology of Fermentation. Professor KNUDSON and Assistant Professor CURTIS.

Advanced Plant Physiology. Professor KNUDSON and Assistant Professor CURTIS.

Special Chapters in Metabolism. Professor KNUDSON.

Research in Plant Physiology. Professor KNUDSON and Assistant Professor CURTIS.

Research in Plant Pathology. Professor REDDICK.

Seminary in Plant Physiology. Professor KNUDSON and Assistant Professor CURTIS.

## PLANT BREEDING

Professors: R. A. EMERSON; H. H. LOVE; C. H. MYERS; C. B. HUTCHISON;  
A. C. FRASER; F. P. BUSSELL.

Instructor: E. DORSEY.

The laboratories of this department are supplied with calculating machines necessary for statistical investigations; have the necessary microscopes, microtomes, paraffin ovens, etc., for studies of the histological phases of genetic problems; and are equipped with cameras and accessories for photographic work. The departmental library contains the principal books and periodicals dealing with plant breeding, evolution, and general genetics. The department has greenhouse room approximating 2000 square feet of floor space, a part of which is available for the use of graduate students. These houses are divided into compartments in which can be maintained temperatures suitable for diverse types of plants, and are equipped with the necessary appliances for the care of plant cultures on a small scale. A garden near the laboratories affords the necessary room for most of the plant material used by graduate students. For more extensive plantings, room is provided on one of the University farms.

In order to enter upon graduate work in plant breeding, the student should have had the equivalent of the following courses: genetics, plant breeding, general botany, general plant physiology, elementary zoology or biology, introductory inorganic chemistry, and elementary organic chemistry. In case a student has not had all these elementary courses, he should take them early in the period of his graduate study, and since he will not be permitted to present them as partial fulfillment of the requirements for a major or a minor in plant breeding, he will ordinarily find it impossible to complete his graduate work in the minimum time.

In addition to the prerequisites listed above, it is desirable that upon entering his graduate work the student should have had the equivalent of the following courses: plant taxonomy, plant cytology, advanced plant physiology, plant pathology, and courses in either farm crops, pomology, floriculture, or vegetable gardening.

No graduate student may take both a major and a minor or two minors in this department. All graduate students in plant breeding are expected to take the courses in biometry and advanced genetics given in this department; to attend the seminary throughout the entire period of their residence; to carry out satisfactorily a course of systematic reading; and to complete such other assignments as may be made in individual cases. In addition to the above, all graduate students whose major work is in this department will be required to complete creditably some problem in genetic research. This requirement will ordinarily hold also for candidates for the doctorate who are taking Plant Breeding as a minor subject.

Students majoring in plant breeding will ordinarily find it necessary to remain in Ithaca during the summer, or to make satisfactory arrangements for growing and studying elsewhere the plant materials used in connection with their research problems. Since the department has accommodations for only a limited number, prospective students will find it to their advantage to correspond with a member of the departmental staff some months prior to entering upon their work.

Genetics, Plant Breeding.

Biometry. Professor LOVE.

Advanced Genetics. Professor HUTCHISON, and Assistant Professor FRASER.  
Research. Professors EMERSON, LOVE, MYERS, HUTCHISON, and Assistant  
Professors FRASER and BUSSELL.

Seminary. Professors EMERSON, LOVE, MYERS, HUTCHISON, and Assistant  
Professors FRASER and BUSSELL.

### PLANT PATHOLOGY

Professors: H. H. WHETZEL; M. F. BARRUS; H. M. FITZPATRICK; F. M. BLODGETT; L. M. MASSEY; CHARLES CHUPP; H. W. DYE; H. E. THOMAS.

Instructors: R. S. KIRBY; M. D. LEONARD; C. CHARDON; Dr. C. N. JENSEN; E. E. HONEY.

The laboratories of the department are supplied with a full equipment of apparatus for teaching and research in this subject, many pieces of apparatus for use in connection with specialized research problems being available, and additional equipment may be supplied when the need arises. Greenhouse space, approximating 2500 square feet of floor space, furnishes excellent facilities for experimental work and for the culture of diseased and healthy plants for class use. These houses are divided into compartments, thus making it possible to maintain conditions of temperature and moisture suitable for diverse types of plants and of experimental work. A garden near the laboratories is available for the use of graduate students. Field laboratories in important crop sections of the State are maintained through co-operation with growers. These provide certain graduate students who receive Fellowships (several of which are usually available each year) with an opportunity for pursuing investigations on a large scale under the most favorable commercial conditions.

The pathological herbarium includes a local collection of fungi and pathological materials, and sets of several of the well known fungous exsiccati. The library contains most of the important works on plant pathology, mycology, and bacteriology, complete sets of the more important journals, many monographs, and practically all the experiment station literature on these subjects.

Candidates for the doctor's degree should spend at least one season in the field in order to come in contact with the practical aspects of control problems. Students preparing for graduate work in Plant Pathology are urged to obtain a thorough knowledge of elementary Physics and Chemistry, including Organic and Physical Chemistry, and of General Botany, Plant Histology, and Plant Physiology. A reading knowledge of Latin, French, and German is indispensable in phytopathological research and must be acquired before the beginning of the second year of graduate work. Candidates for advanced degrees must have fundamental training in the subjects enumerated above. Opportunity is afforded for further study in these subjects after entering the graduate school, but a student availing himself of this opportunity can not expect to receive a degree in the minimum amount of time required for residence.

General Plant Pathology; Principles of Plant Disease Control. Professor WHETZEL.

Disease in Plants (Advanced). Assistant Professor MASSEY.

Mycology. Assistant Professor FITZPATRICK.



History of Phytopathology. Lectures and library work. Professor WHETZEL.  
Research. Professor WHETZEL, and Assistant Professors FITZPATRICK,  
BLODGETT, MASSEY, DYE, and Dr. BURKHOLDER.  
Seminary. Members of the staff.

### POMOLOGY

Professors: A. J. HEINICKE; W. H. CHANDLER; R. W. REES; L. H. MACDANIELS; U. P. HEDRICK; D. B. CARRICK; G. W. PECK.

In addition to the laboratory equipment, there is a fifty-acre field laboratory devoted to commercial and varietal orchards of the different fruits. A special effort has been made to secure in this collection representative varieties of all domesticated species.

Each year a large collection of fruit available for graduate use is brought together at the college. Laboratory equipment is secured as needed for any student carrying on major or minor work in this field as a candidate for the degree of Doctor of Philosophy.

Graduates of Cornell University must offer the following courses as prerequisites for graduate work in pomology: botany 1 and 20, entomology 3, plant pathology 1, chemistry 1, and 30 or 32, and pomology 1 and 8. These courses are outlined in the announcements of the College of Agriculture and of the College of Arts and Sciences. Graduates from universities other than Cornell must offer the equivalent of the above prerequisites. In addition, students are required as a part of their graduate work in pomology to take advanced courses in plant physiology, unless a minor is chosen in that subject. They are urged, however, to choose a minor in some phase of botany, particularly plant physiology.

On account of the nature of the work, it is very desirable that graduates studying for the Master's degree should spend one summer at Ithaca or in the field investigating their special subject. This is also expected of graduates working for the Doctor's degree.

Pomology.

Varieties, Judging.

Packing fruit for market.

Economic Fruits of the World. Professor MACDANIELS.

Orchard Field Trip. Professors HEINICKE and MACDANIELS.

Experimental Pomology. Professors CHANDLER and HEINICKE.

Advanced Laboratory. Professors HEINICKE, MACDANIELS, and CARRICK.

Research. Professors CHANDLER, REES, HEINICKE, MACDANIELS, HEDRICK, CARRICK, and PECK.

Seminary. Professors CHANDLER, REES, HEINICKE, MACDANIELS, HEDRICK, CARRICK, and PECK.

### FLORICULTURE

Professors: E. A. WHITE; A. C. BEAL; ARNO H. NEHRLING.

Instructors: Miss L. A. MINNS; H. A. PRATT.

The field of investigation and research in floriculture is a broad one, and there are excellent opportunities for original work in this subject. Studies in variation,

nutrition, or in regard to the culture and improvement of plants may be undertaken. Monographic studies on the various genera of ornamentals offer an important field of research. Summer work is of special importance in studying flower crops, and it is desirable that candidates for the Master's degree spend at least one summer at the University. This is required of all candidates for the Doctor's degree.

Every candidate for an advanced degree in floriculture must have had a thorough training in general biology, botany, economic entomology, soils, fertilizers, and genetics. A student who takes his major subject in Floriculture must already have had the courses noted below or their equivalent, excepting only the advanced courses. A student who takes his minor subject for the Master's degree in this department of study may register for these courses.

In addition to the classroom and laboratory equipment, a range of greenhouses, aggregating sixteen thousand square feet of glass, is now available for instructional purposes. The department has about thirty acres of land devoted to field experiments with peonies, gladioli, irises, roses, asters and other annual and perennial plants. This area also furnishes material for laboratory exercises.

The library equipment consists of a large and steadily increasing collection of works of reference, comprising a number of the rarer books of the ancients, and unusually full assortment of the garden herbals of the sixteenth, seventeenth, and eighteenth centuries, and the leading monographs and manuals of modern times, supplemented by complete sets of a large number of the horticultural journals of Europe and America. The largest bound collection of seed, plant, and nursery catalogues in the United States is in the library of the department. This collection is very useful to students monographing horticultural plants. Students have access to an herbarium comprising about thirteen thousand cultivated plants.

Principles and Methods of Greenhouse Practice. Assistant Professor NEHRLING.

Greenhouse Construction. Assistant Professor NEHRLING and Mr. PRATT.

Commerical Floriculture. Assistant Professor NEHRLING.

Floral Arrangement. Professor WHITE and Miss MINNS.

Conservatory Plants. Assistant Professor NEHRLING.

Garden Flowers. Miss MINNS.

Amateur Floriculture. Miss MINNS and Mr. PRATT.

History and Literature of Floriculture. Professor BEAL.

Investigation in Floriculture. Professors WHITE and BEAL, and Assistant Professor NEHRLING.

Seminary. Professor WHITE and staff.

## ZOOLOGY

Professors: H. D. REED; A. H. WRIGHT; A. A. ALLEN; B. P. YOUNG.

Opportunity is offered for investigation in general zoology, systematic zoology, ecology, comparative anatomy, and ornithology.

The museum contains representative forms of the various animal groups. In its formation, efforts have been made to obtain material from all parts of the world illustrating biologic and evolutionary ideas. Most of the families of

animals are represented in the collection, and, in some of the major groups, most of the genera.

The large fauna of the Cayuga Lake basin, with its admixture of the Transitional, Canadian, and Upper Austral life zones and with its diverse topographic conditions, affords unusual opportunities for advanced work and research in ecology.

Every facility possible in the way of material and apparatus is placed at the disposal of students desiring to work in the above fields.

Aside from the elementary courses mentioned below, a student should have had courses in histology and embryology. For investigation in ecology, a knowledge of the fundamentals of physics, chemistry, geology, physiology, and botany is necessary.

Comparative Zoology: Comparative Anatomy; Mammalian Anatomy based upon a study of the cat; Comparative Morphology of Invertebrate Animals; Systematic Zoology and Ecology. (These courses or their equivalents and courses in Histology and Embryology, and in botany are prerequisite to graduate work.)

Comparative Morphology and Evolution of Vertebrates. Professor REED.

Comparative Morphology of Invertebrates. Assistant Professor YOUNG.

Systematic Ichthyology, Herpetology, Mammalogy, and Zoogeography. Assistant Professor WRIGHT.

Economic Ornithology and Mammalogy. Systematic Ornithology. Assistant Professor ALLEN.

## ENTOMOLOGY AND LIMNOLOGY

Professors: J. G. NEEDHAM, Entomology and Limnology; O. A. JOHANNSEN, Entomology; G. W. HERRICK, C. R. CROSBY, R. MATHESON, Economic Entomology; J. C. BRADLEY, Systematic Entomology; G. C. EMBODY, Aquiculture; P. W. CLAASSEN, Biology.

Instructors: C. F. W. MEUSEBECK; M. D. LEONARD; L. A. HAUSMAN; W. H. WELLHOUSE; J. D. DETWILER.

Students are offered opportunity for advanced work in one or more of the following subjects: insect ecology, morphology of insects, embryology of insects, systematic entomology, economic entomology, insect parasitism, limnology, and aquiculture.

Each of the laboratories is well supplied with microscopes and other apparatus necessary for the special work carried on in it. The laboratory of morphology and embryology is especially equipped for histological work. Connected with the laboratory of systematic entomology are extensive collections of both North American and exotic insects of all orders. These have been determined by specialists and are accessible to properly prepared students for comparison. The collection includes many sets of specimens illustrative of the metamorphoses and habits of insects. There is also in the museum a good series of invertebrates other than insects, and there are many types. The advanced work in economic entomology is carried on in large part in an insectary, a separate building; a second insectary adjacent to the laboratories is available for other phases of the work. A biological field station at the head of Cayuga Lake, half a mile from the Campus, a hatching station in Cascadilla Gorge on the Campus, and a fish-

cultural experiment station on the University farm afford exceptional opportunities for investigations in the biology of fresh water organisms.

The special library is rich in works on entomology and contains complete sets of all the more important entomological journals.

The following courses, except apiculture, or their equivalents, are prerequisite to graduate study in entomology.

General Biology; General Entomology; Ecology of Insects; Elementary Morphology of Insects; Elementary Systematic Entomology; Entomotaxy; Apiculture.

### **Systematic Entomology**

Research in Systematic Entomology. Professors BRADLEY, NEEDHAM, and JOHANNSEN.

Advanced Systematic Entomology. First and third terms. Professor BRADLEY.

Taxonomy of Insects: a series of courses, running through eight terms, dealing with all the orders of insects in succession. Professors BRADLEY, JOHANNSEN, and NEEDHAM.

B. Homoptera. Third term, 1921. Professor BRADLEY.

G. Hymenoptera. First term, 1921-22. Professor BRADLEY.

E. Diptera. Second term, 1921-22. Professor JOHANNSEN.

D. Lepidoptera. Third term, 1922. Dr. FORBES.

[Orthoptera, Neuroptera, Coleoptera and Heteroptera.] Not given in 1921-22.

[Classification of the Coccidae. Professor BRADLEY.] Not given in 1921-22.

Entomological Literature and its Technics. First Term. Professor BRADLEY.

### **Insect Morphology**

Research in Morphology of Insects. Professor JOHANNSEN.

Morphology and Development of Insects. Professor JOHANNSEN.

Histology of Insects. Professor JOHANNSEN.

### **Economic Entomology**

Economic Entomology and Insectary Methods. Assistant Professor MATHESON.

Forest Insects. Professor HERRICK.

Parasites and Parasitism. Assistant Professor MATHESON.

The Relations of Insects to Disease. Assistant Professor MATHESON.

Research in Economic Entomology. Professor HERRICK and Assistant Professor MATHESON.

Advanced Work in Parasitology. Assistant Professor MATHESON.

See also Systematic Entomology, Course 12, Taxonomy of Insects:

### **Ecology and Limnology**

Research in Ecology of Insects. Professor NEEDHAM.

Research in Limnology. Professor NEEDHAM and Professor EMBODY.

General Limnology. Professor NEEDHAM.

Research in Aquiculture. Professor EMBODY.

Seminary.



**HISTOLOGY AND EMBRYOLOGY**

**Professor:** B. F. KINGSBURY.

**Instructors:** JOHN S. LATTA; R. R. HUMPHREY.

The equipment of this subject comprises a supply of modern microscopes, camera lucidas, polariscopes, microspectroscopes, photomicrographic cameras, and other special apparatus, in sufficient number to give each student opportunity for learning to use them, and for applying them to any special study in which they are needed. Two projection microscopes are available for blotting paper and wax plate reconstructions. The general and research laboratories are large and are equipped with microtomes, incubators, aquaria, etc. The collection of specimens is large and constantly increasing, and comprises preserved material and embryos, as well as embryological and histological series of microscopic preparations of man and mammals and the lower vertebrates.

In addition to the general laboratory, preparation room, and private laboratory rooms for the staff, there are for this subject a large and well lighted advanced laboratory with three small rooms for individual workers, a photomicrographic laboratory and dark room, and a drawing and projection room. A museum of embryological models occupies the center of the advanced laboratory. The rich and varied fauna of the Cayuga Lake region affords favorable opportunity for investigation in the histology and embryology of all the main groups of vertebrates; material for the study of the development of the sheep, cow, and pig, is also available. Advanced work in histology and embryology is of necessity individual and is abundantly provided for. In addition advanced students are sometimes recommended to take some one or more of the general courses in the subject. As preliminary to graduate work, students are expected to have had the courses in the tissues and one of the following: the organs, special histology, embryology, the nervous system and organs of special sense. A year's work in zoology, biology, anatomy, or physiology may with advantage precede advanced work in this subject.

The Tissues; The Organs; Embryology; The Nervous System and Organs of Special Sense.

Advanced Work in Histology and Embryology. Professor KINGSBURY and instructors.

Seminary in Histology and Embryology.

**PHYSIOLOGY AND BIOCHEMISTRY**

**Professors:** SUTHERLAND SIMPSON; J. B. SUMNER.

**Instructors:** A. BODANSKY; S. R. BURLAGE; H. S. LIDDELL.

For advanced and graduate work in experimental physiology two large laboratories and several smaller rooms are available. Laboratory A, on the first floor of Stimson Hall, is provided with electro-motor-driven shafting and Sherrington recording drums of the most recent pattern, capable of giving wide ranges of speed. All necessary apparatus is available for graphic work in muscle and nerve physiology, for the investigation of problems in connection with the circulatory

and respiratory systems, where objective records are desirable (for example, movements of the excised amphibian and mammalian heart), and for the experimental study of the special senses and the central nervous system. Pendulum and spring myographs are available and several forms of ergograph for the study of muscular and nervous fatigue. Each table is supplied with chronographs and time-recording tuning-forks, induction machines, keys, switches, commutators, etc. Adjoining this laboratory are two smaller rooms; one is being equipped for experimental work on animal heat and body temperature, the other contains a Ludwig kymograph with accessories, and is used primarily for experimental pharmacology. There is also a dark room for photographic and optical work.

Laboratory B is devoted exclusively to research. The equipment includes haemomanometers and blood-pressure apparatus of the most recent type, and six large Brodie kymographs for continuous smoked paper. A time-recording clock and artificial respiration and chloroform apparatus have just been added. Plethysmographs for recording volume changes in the various bodily organs are provided, and several clock-driven drums are available.

In connection with this laboratory there is a workshop with a skilled mechanic who is capable of making and modifying any kind of apparatus which may be required for special research.

In the basement, on a solid concrete floor, a room has been equipped with galvanometers, capillary electrometers, shunts, rheocords, bridges, and all the other apparatus required in electrophysiology.

The biochemical laboratories on the second floor of Stimson Hall include a general laboratory, and a smaller laboratory for research, both fitted throughout with water, gas, suction pumps, and draught cupboards. Adjoining these are a room for metabolic work, a balance room, a constant temperature room, and storerooms for chemicals and apparatus.

The equipment, which is being steadily increased along many special lines, is suited to the investigation of problems connected with the chemistry and functions of the animal body, and includes, besides a stock of glass apparatus and the ordinary fittings of a chemical laboratory, several metabolism cages, large and small balances, polarimeter, large centrifuge, Buchner press, incubators, and a selection of the most important works of reference. The principal periodicals dealing with physiology and biochemistry are also kept in the building.

A problem demanding original investigation is prescribed for each student, who is guided in his choice of a subject by one of the professors in charge, due consideration being given to his previous training and to the line of work in which he desires to specialize. Having selected a subject, the student will be expected to concentrate his efforts upon it. While the work is done under the supervision of some one of the members of the teaching staff, and every facility provided in the way of apparatus, etc., the student is encouraged to rely on his own resources as far as possible, especially in planning and carrying out his experiments. Any special apparatus which he may require or which he may himself design, will be made for him by the laboratory mechanic. It is expected that the results of his work will be embodied in a thesis, and if this is judged to be of sufficient merit it will be published in full or in abstract in some accredited scientific journal.

In addition to this specialized work, in order to give breadth of view, a course of reading will be assigned from time to time. This will be supplemented periodi-

cally by a colloquium at which current literature will be reviewed, and original papers presented for discussion.

Physiology of the Cell, Muscle, Nerve, Heart and Circulation, Blood and Lymph, and Respiration; Physiology of Digestion, Excretion, Internal Secretion, Animal Heat and Reproduction; Elementary Human Physiology; Experimental Physiology; Laboratory Work in Physiology; Elementary Biochemistry; General Biochemistry; Practical Biochemistry.

Physiology of the Nervous System and Special Senses. Professor SIMPSON.

Special Chapters in Biochemistry. Assistant Professor SUMNER.

Advanced Work and Research in Physiology. Professor SIMPSON.

Advanced Work and Research in Biochemistry. Assistant Professor SUMNER.

Seminary in Physiology and Biochemistry. Professors SIMPSON and SUMNER.

## ANATOMY

Professors: A. T. KERR; J. W. PAPEZ.

The laboratories for this subject are situated on the third floor of Stimson Hall and are admirably lighted and thoroughly ventilated. For gross dissection there is a large general laboratory, and adjoining the dissecting room is a smaller laboratory for special work, fitted with a hood and other facilities for digestion, maceration, corrosion, etc. At the end of the main dissecting room is a large dark room with a projection outfit and facilities for drawing sections for making reconstructions. Upon this floor also is situated a dark room with a complete outfit for taking photographs of special preparations for illustrating research. In the basement is a compressed air apparatus for embalming and making special injections.

There is an abundance of anatomical material, which is embalmed and kept in cold storage so as to be ready for use when needed. The refrigerating apparatus is also used for freezing specimens for sections. In addition to the undissected material, there is an ample supply of special parts, such as bones, brains, the various abdominal and thoracic organs, special sense organs, etc.

The equipment includes dissecting microscopes, microtomes, glassware, reagents, and other necessities of an anatomical laboratory.

In collaboration with the department of Histology and Embryology, every facility is offered for studying anatomical problems from both the gross and the developmental points of view.

In the library are to be found complete sets of practically all the important periodicals dealing with anatomy, and the proceedings and transactions of the learned societies. In addition, the library is well supplied with the most important anatomical monographs and books.

Graduate work in anatomy should be preceded by courses in general biology and comparative or human anatomy. A reading knowledge of German and French is essential for successful research in anatomy.

Anatomy; Dissection of the upper extremity; of the head and neck: of the thorax; of the lower extremity; of the abdominal and pelvic walls and viscera. Thoracic and abdominal viscera, section demonstrations.

Central Nervous System and organs of special sense. Laboratory work on gross and microscopic preparations. Professors KERR and PAPEZ.

Anatomy. Advanced work and research. Professors KERR and PAPEZ.

Anatomy of the Live Body. Professors KERR and PAPEZ.

Detailed topographical dissection and study of any region. Professors KERR and PAPEZ.

Dissection of the entire human body. Professors KERR and PAPEZ.

Research and Advanced Work. Professors KERR and PAPEZ.

### COMPARATIVE PATHOLOGY AND BACTERIOLOGY

Professors: V. A. MOORE; W. A. HAGAN; S. A. GOLDBERG.

The laboratories in comparative pathology and bacteriology are well equipped for research in general pathology, the pathology of infectious diseases, and for bacteriological work, especially in connection with animal bacterial flora, pathogenic organisms, and problems associated with the morphology and physiology of bacteria and their products. The library facilities are good.

Candidates for advanced degrees taking their major subject in pathology or bacteriology should have had courses in general pathology or in bacteriology equivalent to the corresponding courses given in this department. Candidates electing a minor subject in this department may take the courses in general pathology and bacteriology.

General Pathology: Special Pathology: Pathology of Infectious Diseases; Parasites; Laboratory Methods of Diagnosis: Post Mortem Examinations; Meat and Dairy Inspection.

Research in Bacteriology and Pathology. Professors MOORE, GOLDBERG, and HAGAN. Prerequisite, Microscopy and normal histology.

Seminary. Professors MOORE, GOLDBERG, and HAGAN.

### VETERINARY PHYSIOLOGY

Professors: P. A. FISH; C. E. HAYDEN.

The department has a good equipment for the study of physiological problems in connection with the domesticated animals. The laboratories, located in the Veterinary College, are ample and are provided with modern apparatus for such research as can best be conducted in the laboratories. In the same building there is a well assorted collection of recent books and periodicals on comparative physiology, which may be supplemented by the many works on general physiology in the University Library.

The Veterinary Experiment Station, controlled by the College, and not far distant, can be utilized for field observations and the study of those problems outside of the scope of the laboratory. This unusual combination of field and laboratory research should be conducive to important results.

As a preparation and aid in this research, attendance at the general lecture and laboratory courses in veterinary physiology is recommended.



Physiology Recitations; the Physiology of the Nutrition and Secretion of the Domesticated Animals; the Physiology of the Muscular and Nervous Systems; Physiological Laboratory; Course in Urine Analysis.

Advanced Physiology. Professor FISH and Assistant Professor HAYDEN.

### VETERINARY SURGERY

Professor: J. N. FROST and Dr. VARLEY.

The laboratory in Surgery is well equipped for research and special study along surgical lines, especially in connection with diseases of the bones, tendons, and tendon sheaths.

Candidates for advanced degrees should have as preliminary preparation general pathology, physiology, general and special surgery.

Special Surgery. Professor FROST and Dr. VARLEY.

Research in Surgical Diseases. Professor FROST and Dr. VARLEY.

### DISEASES OF BREEDING CATTLE

Professor: R. R. BIRCH.

The department has available for research in connection with the diseases of breeding cattle a small herd of experiment cattle, with accurate history throughout the lives of the animals.

The department has also an extensive collection of laboratory material relating to the diseases of the genital organs of cattle.

In addition, observations are being conducted upon herds at varying distances from the University, in which research students may participate.

Extensive research work upon the diseases of the genital organs of cattle, with special reference to the phenomena of sterility, abortion, and other serious diseases, are being constantly conducted. The bacteriological features of the work are carried out by the Department of Pathology, in conjunction with the clinical studies made in this Department.

### SOIL TECHNOLOGY

Professors: T. L. LYON; J. A. BIZZELL; H. O. BUCKMAN; J. K. WILSON; B. D. WILSON.

Special laboratories are provided for graduate students and these are equipped for chemical, bacteriological, and physical investigations of soil. The usual facilities for the chemical analyses of soils and plants are at hand, and permit the determination of all the constituents of the soil concerned in plant nutrition. For bacteriological work, the laboratory contains in its equipment autoclaves, sterilizers, incubators for different temperatures; and for mechanical analyses, centrifuges, shaking machines, and other necessary apparatus. Two greenhouses provide opportunity for conducting crop tests of soils during the winter, and for experiments with nutrient solutions and sand cultures. A field for plat experi-

ments gives ample facility for work on a larger scale. In this field a series of lysimeters, each holding between three and four tons of soil have been built. Pipes from these tanks carry the drainage water into a tunnel where it is collected for measurement and analysis. These varied and extensive facilities afford opportunity for students trained in any one or more of several sciences to investigate soil or plant nutrition problems.

There are, in addition, several hundred samples of soil from all parts of the United States for comparison and classification. All the soil maps of the United States are arranged in form for ready reference. The University Library is unusually well supplied with the publications in which the literature of soil science is to be found.

A graduate student who desires to make soil technology his major subject should have had sufficient training in analytical chemistry or in bacteriology to give him a command of the technique as well as the principles of the subject. It is also desirable that he should have had enough technical agriculture to enable him to see the agricultural bearing of the work.

Introductory Course, Soil Management.

Soil Surveying and Mechanical Soil Analysis. Professors BUCKMAN and BIZZELL.

Soils, Advanced Course. Professor BIZZELL.

Soil Bacteriology. Professor J. K. WILSON.

Research in Soils. Professors LYON, BIZZELL, BUCKMAN, and J. K. WILSON.

Seminary. Professors LYON, BIZZELL, BUCKMAN, J. K. WILSON, and Assistant Professor B. D. WILSON.

## RURAL ECONOMY

Professor: G. N. LAUMAN.

It is not expected that all students of the subject will have a general knowledge of scientific agriculture in addition to training in economics and history; but for those who expect to specialize in this subject, a knowledge of the technical side of agriculture is strongly recommended. Many problems, however, may be successfully studied without the more technical training.

The library collections, general and departmental, are unusually complete. Much attention has been given to collecting the literature dealing with the economic and social conditions of agriculture in Western Europe. The literature of the technical side of agriculture, containing as it does a wealth of data as yet little used, is available and is relatively complete.

Since many non-technical rural problems are best studied by actual contact with the population, the close relations with the rural community maintained by the College of Agriculture in its extension work may prove advantageous to graduate students in carrying on their investigations.

Agriculture.

Economic Status of the Rural Community.

Rural Economy.

History of Agriculture.

Marketing and Prices.

Co-operation.

Investigation.

**RURAL EDUCATION**

Professors: G. A. WORKS; P. J. KRUSE; R. M. STEWART; W. J. WRIGHT; J. E. BUTTERWORTH; T. H. EATON; CORA E. BINZEL; ANNA B. COMSTOCK; O. G. BRIM; E. N. FERRISS; E. L. PALMER; EMMA JOHNSON.

Persons desirous of undertaking graduate work in Rural Education should arrange by correspondence or conference with the department before entering the Graduate School. The department reserves the right to accept only persons who have had adequate training and experience for the work.

Educational Psychology, Principles of Teaching, Agriculture in the High School, Home Economics in the High School, Teaching, Nature Study.

Educational Measurement. Professor KRUSE.

Social and Vocational Aspects of Education. Professor STEWART.

Organization of Teacher-Training for Vocational Agriculture. Professor EATON.

Rural Secondary Education. Assistant Professor FERRISS.

State and County School Administration. Professor BUTTERWORTH.

Seminary in Rural School Administration. Professor BUTTERWORTH.

Administration and Supervision of Vocational Agriculture. Professor WORKS.

Educational Psychology. Professor KRUSE.

Principles of School Supervision. Professor BRIM.

Investigation.

**RURAL SOCIAL ORGANIZATION**

Professor: DWIGHT SANDERSON.

Acting Professor: WARREN S. THOMPSON.

Graduate students who desire to register in Rural Social Organization as a major subject should have had a considerable personal experience with rural life and rural institutions. Training in the technical branches of agriculture is highly desirable, and a substantial knowledge of scientific agriculture, including farm management and rural economy, is essential. Students should have a general knowledge of sociology, economics, history, and political science. Attention is called to the opportunity for arranging courses of study in the nearly related departments of Rural Education, Agricultural Economics and Farm Management, the announcements of which should be consulted. Special attention will be given to affording facilities for graduate study to agricultural extension workers, and those employed in positions of leadership in country life. Investigations will usually require more than one year's residence, but in some cases may be initiated while in residence and completed after the candidate has left the institution.

The Rural Community.

Rural Community Organization.

Social Psychology of Rural Life.

Farmer's Organizations.

Rural Social Surveys.

Investigation in Rural Social Problems.

**FARM CROPS AND VEGETABLE CROPS**

Professors: E. G. MONTGOMERY; H. C. THOMPSON; PAUL WORK; E. V. HARDENBURG; R. G. WIGGANS; H. W. SCHNECK.

Before undertaking graduate work in farm crops and vegetable crops, the student should have had a general scientific training (six hours in botany, ten hours in chemistry, four hours in geology, and six hours in physics), equivalent to courses in Cornell University, as well as at least five hours of university work in soils and crops. Graduate work is offered in both Farm Crops and Vegetable Crops.

Cereals; Forage Crops; Special Cash Crops; Principles of Vegetable Gardening; Advanced Vegetable Gardening; Vegetable Forcing.

Farm Crops. Advanced course, principally a review of experimental evidence. Professor MONTGOMERY.

Taxonomy of Cereals. The morphology and classification. Assistant Professor WIGGANS.

Seminary. Professors MONTGOMERY, THOMPSON, WORK, and WIGGANS.

Research. Professors MONTGOMERY, THOMPSON, WORK, WIGGANS, HARDENBURG, and SCHNECK.

**FARM MANAGEMENT**

Professors: G. F. WARREN; G. P. SCOVILLE; E. G. MISNER; W. I. MYERS; C. V. NOBLE; C. E. LADD; H. E. BABCOCK; J. E. BOYLE.

Instructors: L. J. NORTON; E. C. YOUNG; H. P. YOUNG; L. SPENCER; F. A. PEARSON.

Research work in farm management requires a familiarity on the part of the student with farm practice and also a knowledge of the scientific principles involved in the production of crops and animals. A knowledge of the principles of economics is also essential.

Only those persons who have spent several years in farm work, and who have had training in economics and in subjects dealing with the production of crops and animals, are advised to take a major in this subject.

Cost Accounting. Assistant Professor NOBLE and Mr. SPENCER.

Farm Management. Professor ———.

Farm Organization. Professor MISNER.

Types of Farming in the United States. Professor WARREN.

Agricultural Statistics. Professor WARREN and Mr. PEARSON.

Agricultural Prices. Professor WARREN and Mr. PEARSON.

Seminar. Professors WARREN, BOYLE, SCOVILLE, MISNER, MYERS, BABCOCK, LADD, and NOBLE.

**ANIMAL HUSBANDRY**

Professors: H. H. WING; M. W. HARPER; E. S. SAVAGE; L. A. MAYNARD; R. B. HINMAN.

Instructors: C. L. ALLEN; GEORGE HAINES; S. F. BITTNER; L. C. NORRIS; J. K. BAILDON; R. G. KNAPP.

Among the herds and flocks belonging to the College of Agriculture may be mentioned the dairy herd of fifty cows, a stud of Percheron horses, a flock of



about 150 sheep of various breeds, and a herd of breeding swine. The equipment for animal husbandry includes a very full collection of the herd and flock registries of all the breeds of domestic animals kept in this country, amounting to more than one thousand volumes, and affording excellent facilities for studies in heredity and genetics. Further work may be carried on in problems of animal nutrition based on investigation with the animals themselves. A fully equipped chemical laboratory is available to graduate students in animal nutrition.

Animal Husbandry; Meat and Milk Production; Practice in Feeding<sup>7</sup> and Stable Management; The Horse; Mechanics of the Horse; Advanced Stock Judging; Principles and Practice of Feeding; Principles of Animal Breeding; Practical Horse Training; Dairy Cattle; Beef Cattle, Sheep, and Swine.

Advanced Course in the Principles of Animal Genetics. Professors WING and HARPER, and Mr. HAINES.

Advanced Course in the Principles of Feeding. Professors SAVAGE and MAYNARD.

Commercial Feedingstuffs. Professor MAYNARD.

Mechanics of the Horse. Professor HARPER.

Advanced Course in Beef Cattle, Sheep, and Swine. Professor HINMAN.

## POULTRY HUSBANDRY

Professors: J. E. RICE; E. W. BENJAMIN; O. B. KENT; G. F. HEUSER; H. E. BOTSFORD.

Instructors: L. E. CARD.

This department of study is well equipped with facilities for carrying on advanced work. The equipment includes over 2000 fowls with which to carry on feeding and breeding experiments, and also appliances for investigation in incubation, breeding and artificial illumination. The laboratories and equipment provide facilities for anatomical work. In addition to a very complete set of bulletins in the poultry library, assembled from the various Experiment Stations in the United States and Canada, numerous books on poultry husbandry are available in the University Library, the library of the College of Agriculture, and the special departmental library. The department is also provided with a topical card index, with cross references, of the principal poultry books, bulletins, and magazines; a large mass of data from research; 5,560 negatives, a large number of which have to do with poultry investigations; and 2,300 lantern slides.

The poultry husbandry building with the new auxiliary buildings furnish facilities for graduate work along many lines of instruction and research. These buildings have been constructed at a cost of approximately \$150,000, and include besides the administration building, laying pens, the fattening house, breed exhibition house, and long brooder house. Over forty varieties of poultry are kept for class use, and facilities are now available for the study of the adaptation of the various breeds, feeds, equipments, methods, etc., to the needs of the various locations and types of poultry farming.

Owing to the fact that many colleges do not give the undergraduate courses in poultry husbandry which are prerequisite to graduate work in the subject,

students coming from other institutions cannot in all cases enter immediately upon graduate study. Many students will find it necessary or desirable to spend a year in preliminary study taking undergraduate courses before beginning graduate work.

Courses of instruction of an advanced nature may be taken along the lines of poultry feeding, breeding, illumination, marketing, co-operation, refrigeration, advertising, house construction, and poultry farm management; and, in co-operation with the staff of the Veterinary College, in poultry disease investigations; in co-operation with the staff in agricultural chemistry, in incubation and nutrition investigations; and in co-operation with the staff in histology and embryology, in incubation experiments.

### Preliminary Courses

Poultry Husbandry, general course; Breeding, Feeding, Incubation, Brooding, and Disease; Feeding Practice; Incubator Practice; Brooder Practice; Breeds and Judging; Poultry House Design and Construction; Market Products; Marketing Practice; Farm Poultry.

Undergraduate Conference.

### Graduate Courses

Advanced Judging. Professor KENT.

Poultry Farm Management. Professor RICE.

Commercial Marketing. Professor BENJAMIN.

Poultry Feeds and Feeding. Assistant Professor HEUSER.

Graduate Seminary. (Required of all Graduate Students.) Professors RICE, BENJAMIN, KENT, Assistant Professors HEUSER, and BOTSFORD and Mr. CARD.

Research. Professors RICE, BENJAMIN, KENT, Assistant Professors HEUSER, and BOTSFORD and Mr. CARD.

### DAIRY INDUSTRY

Professors: W. A. STOCKING; H. E. ROSS; H. C. TROY; E. S. GUTHRIE; W. W. FISK. T. J. MCINERNEY; H. C. JACKSON.

Instructors: W. A. WHITING; P. A. DOWNS; M. P. MOON; R. A. PERRY; H. B. NEVILLE.

The different laboratories of the department are well equipped with apparatus for special work and offer good opportunities to graduate students for research.

Before taking up graduate work in dairy industry, it is desirable that a student should have chemistry course 6, or its equivalent, and bacteriology course 4, or its equivalent, in addition to the elementary courses in the particular subject in which he wishes to do his graduate work.

A limited number of graduate students intending to fit themselves for teaching dairy industry may have an opportunity for practice in instruction in the different laboratories during the winter courses.

It is expected that graduate students in dairy industry will attend the seminary in that subject.

Milk Composition and Tests; Butter Making; Cheese Making; Elementary Bacteriology; Dairy Mechanics; Market Milk and Milk Inspection; Fancy Cheese Making; Ice Cream; General Agricultural Bacteriology; Bacteriology for the Home.

Advanced Testing. Professor TROY.

Dairy Bacteriology. Professor STOCKING.

Advanced Butter Making. Professor GUTHRIE.

Advanced Cheddar-Cheese Making. Professor FISK.

Research. Professors STOCKING, ROSS, TROY, GUTHRIE, FISK, and Assistant Professor MCINERNEY.

Seminary. Professors STOCKING, ROSS, TROY, GUTHRIE, FISK, and Assistant Professor MCINERNEY.

## LANDSCAPE ART

Professors: E. GORTON DAVIS; RALPH W. CURTIS; E. D. MONTILLON.

Graduate work is offered in landscape design, town planning, planting design, history of landscape design, and landscape engineering.

Candidates for the degree of Master in Landscape Design must have completed a course substantially equivalent to the undergraduate course offered by the Department of Landscape Design. Students who have been admitted to the Graduate School, but who have not had preparation adequate to qualify them to become candidates for the advanced degree, may be required to parallel their major lines of study in the department with courses that are required by the department for undergraduates. Further, they may be required to amplify their preparation for work in landscape design by the election of undergraduate work in other colleges of the University. When a student has attained such a status in his work as to be eligible for a master's degree in not more than two years, he may become a candidate for the degree.

This department is well equipped with the conveniences and facilities needed in the prosecution of its work. It is provided with a very complete reference library containing the best and most important literature, both early and modern; many folios of illustrations of noted European and American parks and estates; a collection of several thousand photographs of the best examples of recent landscape work in this and other countries; files of plans and drawings; examples of the technic of drawing and expression; and of the best work of representative practising landscape designers, illustrating their solutions of various types of landscape problems. A large collection of lantern slides supplement all lecture courses, and the same illustrations are accessible for reference in prints catalogued and indexed by subjects. An ample herbarium and a large collection of photographs of plant materials supplement the indoor work in courses in planting design. The University Campus affords an excellent collection of woody plants in mature condition, and an arboretum is rapidly being developed which exhibits all the useful plant forms in arrangement for type study and also in their grouping for various uses.

Advanced work in design and construction is considerably broadened by opportunity for discussion with, and criticism from, well-known visiting lecturers and critics.

Summer work, both graduate or preparatory for graduate work, may be taken in planting design by arrangement with Professor Curtis during the regular period of instruction in the third term of the College of Agriculture.

Elementary Landscape Design; History of Landscape Design; Theory and Aesthetics of Landscape Design; Planning of Private Properties; Planning of Public Properties; Elements of Planting Design; Landscape Design; Landscape Engineering and Details of Construction; Planting Design; Seminary.

Landscape Design. Professors DAVIS and MONTILLON.

Town Planning. Professor DAVIS.

Planting Design. Professor CURTIS.

History of Landscape Design. Professor DAVIS.

Seminary. Professors DAVIS and CURTIS and Assistant Professor MONTILLON.

### FORESTRY

Professors: R. S. HOSMER; S. N. SPRING; A. B. RECKNAGEL; JOHN BENTLEY, JR.; G. H. COLLINGWOOD.

Instructor: C. H. GUISE.

Students who wish to elect a major or a minor subject in forestry, either for a Master's degree or for a Doctor's degree, are offered opportunity for advanced study or research in silviculture, forest management, forest policy, forest protection, and forest utilization.

Candidates for the degree of Master in Forestry must show adequate preparation in the following fundamental subjects or their equivalents: English, inorganic chemistry, solid geometry, trigonometry, plain and topographic surveying, introductory physics, dynamic geology, mineralogy and lithology, general botany, plant physiology, general biology, zoology, general entomology, economics. They must also have satisfactorily completed forestry courses the equivalent of those offered in the four-year undergraduate course of the Department of Forestry, N. Y. State College of Agriculture, leading to the degree of Bachelor of Science. (See Announcement of the N. Y. State College of Agriculture at Cornell University.) In addition, they must have had at least three months' experience in forestry work or in a logging camp, satisfactory proof of which is to be a signed statement, or an examination in woodsmanship, or both. Students who enter as graduates without having had undergraduate instruction in forestry should be able to complete the work for the Master's degree in two years, if they have had satisfactory training in fundamental sciences. If they lack this, it will require a correspondingly longer time to get the Master's degree. Prospective students should write to the Department of Forestry for information regarding the special lines of graduate work which they desire to follow and the term in which to begin in order to meet their special needs.

### Undergraduate Courses

Wood Technology. Professor RECKNAGEL.

Forest Utilization. Professor RECKNAGEL.

Timber Treatment. Mr. GUISE.

Forest Engineering. Professor BENTLEY.



Forest Mensuration. Professor BENTLEY.

Forest Management. Professor RECKNAGEL; Mr. GUISE.

Timber Trees and Forest Regions. Professor BENTLEY.

Silviculture. Forest Ecology. Professor SPRING.

Silviculture. Natural Reproduction and Care of the Forest. Professor SPRING.

Silviculture. Forest Planting and the Forest Nursery. Professor SPRING.

Forest Protection. Professor HOSMER.

Forest Policy, Forest Law, and History of Forestry. Professor HOSMER.

### Courses for Graduate Students

Forest Organization. Professor RECKNAGEL.

This course covers that branch of forestry which concerns itself with organizing a forest property for management. An important part of this course is the preparation of a working plan in camp on a large forest tract in New York State; the course includes practice in forest engineering and field studies in forest administration.

Forest Finance. Mr. GUISE.

That branch of forestry which relates to the forest as an investment.

Forest Administration. Professor RECKNAGEL.

The administrative organization and business practice in federal, state, and private forestry.

Seminary. Field and class room conferences on important phases of forestry conducted by members of the forestry staff.

Advanced work and research. Opportunities for the pursuit of special lines of investigation under the direction of members of the forestry staff.

### RURAL ENGINEERING

Professors: H. W. RILEY; B. B. ROBB; J. C. MCCURDY; F. L. FAIRBANKS.

The laboratory equipment for mechanics—consisting of gasoline engines, spray machinery, pumps, hydraulic rams, water supply systems, steam engine, steam injectors, grain binders, separate binder attachments, plows, separate plow bottoms, tractors, and other apparatus of similar nature—is selected primarily for teaching the elements of applied mechanics.

A limited amount of laboratory space is available through the winter for research; more room can be provided for summer work. A high grade recording traction dynamometer is in process of construction and will be available for research work in tests of draft of implements or tractors. A limited amount of special apparatus each year as required for particular investigations may be designed and built, or bought, without expense to the student. Because of limited storage space very little bulky machinery is retained through the winter, but loans of implements of any kind are easily secured for investigations through the summer.

The preparation required of candidates for advanced degrees in mechanics will vary somewhat with the character of the thesis subject. For problems involving the design of new machines or implements or the comparison of existing

ones there will be required a good working knowledge of mechanical drawing, kinematics, mechanics, and machine design, in addition to an adequate understanding of the purely agricultural features of the work. For problems involving the study of the economic value of certain types of implements, less stress will be laid on engineering preparation and more upon that in farm crops, farm management, and rural economy. Practical farm experience is of almost vital importance for most advanced work in this department. Students deficient in engineering subjects may take necessary work in Sibley College; deficiencies in agricultural subjects may be made up in the College of Agriculture.

The department's equipment for farm engineering consists of fourteen farm levels for use in the elementary course; and for advanced work, an architect's wye level and engineer's light transit for men not well versed in instrument work; while for men competent to use them, there is a fine engineer's transit and precision dumpy level. In addition, the necessary tapes, pins, axes, and leveling and stadia rods are provided.

The preparation necessary for advanced work in farm engineering, as in mechanics, will vary with the thesis subject. In general there will be required a good knowledge of trigonometry, surveying, physics, soils, farm crops, and general agricultural practices and conditions.

Farm Field Machinery; Farm Power Machinery; Farm Mechanics; Dairy Mechanics; Farm Engineering; Drainage; Farm Structures; Farm Shop Work; Mechanical Drawing.

Research in Rural Engineering. Professors RILEY, ROBB, McCURDY, FAIRBANKS.

## EXPERIMENTAL ENGINEERING AND ENGINEERING RESEARCH

### A. Experimental Engineering

Professors: HERMAN DIEDERICHs; G. B. UPTON; V. R. GAGE; A. C. DAVIS.  
Instructors: W. E. MORDOFF; S. MOTT-SMITH; H. W. LEET; E. F. ZEINER;  
R. T. STARR; A. S. GRISWOLD; C. K. MILLER; W. W. WERRING; G. H. ACKER.

**The Materials Testing Laboratory.** This laboratory is equipped for tension and compression tests with an Olsen 300,000 pound machine, an Olsen 100,000 pound machine, a Riehlé 100,000 pound machine, a 200,000 pound Emery hydraulic machine, together with several other machines varying in capacity from 10,000 to 100,000 pounds. For transverse tests there is a Riehlé machine of 200,000 pounds capacity, and a Fairbanks machine of 10,000 pounds capacity. There are an Olsen torsion machine of 200,000 inch-pounds capacity, two Thurston autographic torsion machines, and two Upton-Lewis fatigue testing machines. The equipment includes measuring instruments, such as extensometers, a cathetometer, and other apparatus, such as gas furnaces, and tempering baths, required for the determination of the physical qualities of engineering materials under tensile, compressive, transverse, and torsional stress, and under different kinds of heat treatment.

**The Steam Laboratory.** In this laboratory there is a 150 H. P. triple expansion Allis-Corliss engine so fitted up that it may be run as a simple, compound, or triple engine, condensing or non-condensing. There are also several smaller engines, including a Russell, a Harriss-Corliss, a Payne, a Troy, a Wickes Bros. automatic engine, and a Laidlaw-Dunn Gordon steam pump delivering 300 gallons of water a minute against a pressure of 300 pounds a square inch. There are three surface condensers which may be connected with these engines as desired. There is one 35 kw horizontal Curtis turbine and one 15 kw De Laval turbine. These turbines drive electric generators and may be run condensing or non-condensing.

There are a two-stage steam-driven Ingersoll-Rand compressor, and three air-brake pumps of different types, together with meters, nozzles, and other instruments used in testing. This part of the laboratory also contains several fans, including one of the Sirocco type.

The equipment of apparatus and instruments used for engine testing comprises about 70 indicators of different types, about 75 steam gauges, and a number of calorimeters for the determination of the quality of steam, speed counters, tachometers, planimeters, etc., besides a number of dynamometers of various kinds.

The boiler section of this laboratory has one 150 H. P. Babcock & Wilcox water-tube boiler of the marine type, and one 100 H. P. Babcock & Wilcox water-tube boiler of the standard type both of which are fitted with internal superheaters. There are also one 80 H. P. Heine water-tube boiler and one 25 H. P. Roberts safety boiler connected with a Foster independent superheater. The auxiliary apparatus consists of a Cochrane open heater, a Wainwright, closed heater, steam pumps, traps, injectors, etc. A full set of scales, measuring tanks, gauges, flue gas apparatus, separating and throttling calorimeters, pyrometers, etc., complete the boiler equipment.

**The Gas Engine Laboratory.** The equipment consists of an 8 H. P. Fairbanks gasoline engine, an 8 H. P. Olds gasoline engine, an 8 H. P. Hornsby-Akroyd oil engine, a 15 H. P. Hornsby-Akroyd oil engine, a 16 H. P. Acme gas engine run on producer gas from a 15 H. P. suction gas-producer, an 8 H. P. Ingeco oil engine, a 30 H. P. gasoline marine engine, and a 30 H. P. three cylinder Westinghouse gas engine with gas producer, and a 45 H. P. McIntosh and Seymour Diesel engine direct connected to a D. C. generator. Hot air engines are represented by a Rider and an Ericsson engine. The engine equipment is chosen to give as great a variety as possible in fuel used, types of governing, etc.

The supply of testing instruments includes several outside spring indicators, optical indicators, and a manograph. For temperature measurements there are available high reading thermometers and pyrometers of the expansion and electrical types.

**The Hydraulic Laboratory.** This laboratory contains the following machines and apparatus: a 6-inch single-stage De Laval centrifugal pump; a 2½-inch two-stage Worthington centrifugal pump; a 12-inch Doble water wheel; a 10-inch Trump turbine; several Pelton wheels and hydraulic rams; sets of weir boxes with various types of weirs and nozzles for the determination of coefficients of discharge; various types of water meters and other apparatus for measuring the flow of water, such as Pitot tubes, Venturi meters, current meters, etc.

**The Oil Testing Laboratory.** This laboratory contains a Cornell oil-testing machine, a Thurston standard railway testing machine and several smaller Thurston machines. The rest of the equipment consists of several viscosimeters of different types, flash and burning point apparatus, together with the necessary hydrometers and thermometers.

**The Refrigeration Laboratory.** For the study of refrigeration in all its phases, the mechanical laboratory possesses a very complete York compression refrigerating plant having a capacity of 15 tons of ice, and a two-ton York absorption ice machine.

**The Cement Laboratory.** This laboratory not only contains the ordinary apparatus for the testing of cement and concrete but in addition is equipped with crushing and grinding machinery and a small vertical kiln for making investigations in the manufacture of cement from raw material.

**The Fuel Testing Laboratory.** This laboratory contains a complete equipment of fuel calorimeters, and other apparatus needed for the determination of the composition and calorific value of fuel, whether gaseous, liquid, or solid.

Manufacture of Engineering Materials; Properties of Engineering Materials (laboratory); Introductory Experimental Engineering (laboratory); General Experimental Engineering (laboratory). Also see Engineering Research.

### **B. Engineering Research**

Professors: H. DIEDERICHS; W. M. SAWDON; G. B. UPTON.

Engineering research is under the charge of a separate corps of specialists who devote their entire time to this work and to giving advice and assistance to graduate and undergraduate students who are carrying on investigations in the various branches of mechanical engineering. Much of the work in this subject is conducted in the several laboratories described under Experimental Engineering. The equipment and resources of all other departments of Sibley College are likewise available, and in most instances arrangements can be made to use the equipment of the scientific and engineering departments of the other colleges of the University.

In addition to the well equipped Sibley College library containing reference books, periodical literature, bulletins and transactions of bureaus and societies, relating to mechanical and electrical engineering and allied branches of learning, the graduate student has access to the University Library and to the special libraries of the other engineering and scientific departments of the University. In the University Library is a large collection of research theses, and the Department of Engineering Research has on file the results of many investigations.

(See also courses in Experimental Engineering.)

Engineering Research. Professors DIEDERICHS, SAWDON, and UPTON.

### **ELECTRICAL ENGINEERING**

Professors: A. GRAY; V. KARAPETOFF; J. G. PERTSCH; W. C. BALLARD; R. F. CHAMBERLAIN.

Instructors: G. F. BASON; B. NORTHROP.

**The Lecture Equipment.** The lecture room is exceptionally well provided with display apparatus and with apparatus especially designed for demonstration



purposes. All types of electrical machinery may be operated on the lecture table, and a 60,000 volt transformer is provided for insulator testing.

**The Dynamo Laboratory.** This laboratory is provided with a great variety of standard and special machines for both direct and alternating current work, along with the necessary meters and control equipment. Among the special pieces of equipment are a street car truck with motors and also a complete outfit for exhibiting in actual operation the multiple unit system of electric car control.

**The Standardizing Laboratory.** This laboratory is equipped with the necessary potentiometers, galvanometers and standards for the calibration of instruments, and the testing of materials used in electrical work. There is also a G.E. oscillograph for work on wave form.

**The Radio Laboratory.** The laboratory has two sets of transmitting equipment, one a 500 cycle 5 kilowatt, and the other a 2 kilowatt 60 cycle set. Quenched and rotary gaps and the necessary measuring instruments are included in the equipment.

For work with receiving circuits, a large number of condensers and inductance coils of various dimensions are available in addition to the usual receiving apparatus.

Special facilities are provided for research in connection with electron tubes; complete equipment for the manufacture and exhaustion of the same, including condensation pump, is provided.

An excellent antenna is available for the practical testing of transmitting and receiving circuits, and some exceptional receiving ranges have been attained with the apparatus available.

The power for the various laboratories is obtained from the University Hydro-electric Plant, which contains large three-phase alternators, direct driven by both impulse and reaction water-wheels. This plant is complete in every respect and is used for inspection.

Elementary Electrical Engineering; Theory of Electrical Machinery; Characteristics of Electrical Machinery; Electrical Laboratory; Electrical Design; Generation and Distribution of Electrical Energy; Electric Railway Practice; Engineering Mathematics; Wireless Telegraphy; Special Problems in Electrical Engineering.

Theory of Electrical Machinery. Professor KARAPETOFF.

Characteristics of Electrical Machinery. Professor KARAPETOFF.

Electrical Laboratory. Professors GRAY and CHAMBERLAIN.

Electrical Design. Professors GRAY and PERTSCH.

Engineering Mathematics. Professor KARAPETOFF.

The Graduate Seminary in Electrical Engineering. Professors GRAY and KARAPETOFF.

## MACHINE DESIGN

Professors: C. D. ALBERT; E. F. GARNER; F. S. ROGERS; C. E. TOWNSEND.

Under this head is included advanced instruction in descriptive geometry, kinematics, machine design and design methods, and special design problems.

There are nine well equipped drawing rooms. The Sibley College Library and the University Library have a very complete collection of books on drawing, machine design and construction, structural design, and books on related subjects.

**POWER ENGINEERING**

**Professors:** W. N. BARNARD; F. O. ELLENWOOD; R. MATTHEWS; R. E. CLARK;  
J. GAVETT, JR.; W. H. HOOK.

**Instructors:** P. CHERDANZEFF; W. L. LEWIS; C. M. BIGELOW.

The graduate work conducted under this heading includes investigations in engineering thermodynamics, problems in power plant economics, the selection and arrangement of the equipment of power plants and the design of such equipment. The library is liberally provided with reference books, periodical literature, and transactions of engineering societies relating to these subjects.

Elementary Heat-Power Engineering; Advanced Heat-Power Engineering; Engines and Power Plants (lectures and drafting); Steam Turbine Design; Steam Boiler Design; Gas Power Machinery; Heating and Ventilating; Refrigeration; Motor Cars.

Designing and Special Problems in Heat-Power Engineering. Professors BARNARD, ELLENWOOD, and ———.

**INDUSTRIAL ENGINEERING**

**Professors:** D. S. KIMBALL; A. E. WELLS; M. A. LEE.

Under this heading is included the consideration of the organization, administration, and equipment of industrial enterprises. The library of the college is well supplied with literature relating to the various branches of this field of engineering, and access may be had to the special libraries on economics in the University Library and in the Department of History and Political Science. Attention is directed to the courses in History and Political Science which may be profitably pursued in conjunction with work in industrial engineering.

In order to take the advanced course in this department, the student must not only have had the equivalent of the undergraduate course in mechanical engineering, but must also have taken the courses in industrial engineering and economics required of seniors who elect the special work of this branch.

Industrial Organization; Industrial Administration; Industrial Engineering; Drawing and Design; Safety Engineering and Fire Protection.

Industrial Administration. Professors KIMBALL, WELLS, and LEE.

Drawing and Design. Professor LEE.

Advanced Industrial Engineering. Professors KIMBALL and WELLS.

**MECHANICS AND HYDRAULICS**

**Professors:** E. H. WOOD; S. S. GARRETT; F. G. SWITZER; W. R. CORNELL.

**Instructors:** H. J. HOTCHKISS; H. C. PERKINS; C. B. BENSON; E. L. THEARLE;  
K. D. WOOD; A. ZUIDEMA.

Hydraulic investigations along various lines can be carried on in this department. For experimental work there is available the equipment of the mechanical laboratory and the university hydro-electric power plant. This power plant

contains a reaction turbine operating under 142 feet head and four impulse turbines operating under 135 feet head. The reaction turbine is a 500 H. P. unit built by the I. P. Morris Co. It is direct connected to a 450 Kva alternator. The impulse turbine consists of two 280 H. P. Pelton-Doble wheels driving 150 kw alternators, and two 50 H. P. Pelton-Doble wheels connected to 30 kw. D. C. generators.

The libraries of the University have a very complete collection of treatises relating to mechanics, hydraulics, hydro-electric engineering, and to similar subjects. In addition, these libraries contain the more representative engineering periodicals and the transactions of the leading engineering societies of the world.

Mechanics of Engineering; Hydraulics; Hydraulic Turbines.

Hydraulic Power Plants. Professor SWITZER.

### MECHANIC ARTS

Professor: A. E. WELLS.

The Forge, Foundry, Pattern and Machine Shops in the Department of Mechanic Arts of the Engineering College, are equipped with adequate and modern machinery and tools.

Subject to the approval of the professor in charge, students may utilize the equipment of the shops in connection with graduate work.

### GEODESY AND ASTRONOMY

Professors: S. L. BOOTHROYD, Geodesy and Astronomy; P. H. UNDERWOOD, L. A. LAWRENCE, Topographic and Geodetic Engineering.

Instructor: C. M. PENDLETON.

The geodetic equipment is one of the most extensive in the country. The library facilities in this subject are also unusual, embracing the principal books relating to geodetic work in all parts of the world.

The new observatory contains a dome for a twelve-inch equatorial telescope, and a transit room with four piers for astronomical transits and zenith telescopes.

The geodetic laboratory contains vaults for the investigation of standards of length, for clocks and for gravity and other determinations in which the control of temperature is essential; also a laboratory with piers for the investigation of instruments, a dark room, and a library and computing room.

The following outlines show various classes of work that may be undertaken in these subjects and the character of the equipment.

**Geodesy and Geodetic Methods.** The works of Crandall, Clarke, Jordan, Helmert, and others may be used for special reading. The publications of the United States Coast and Geodetic Survey and of the International Geodetic Association are available for reference.

**Geodetic Astronomy.** Determinations of time, latitude, longitude, and azimuth are considered. Chauvenet's, Doolittle's, and Hayford's books on this subject may be used as texts.

In connection with the study of star positions the library contains an assortment of the standard catalogues of stars and the publications of many of the

leading observatories of the world. Direct observations may be made with the equatorial telescope of four and one-half inches aperture. This instrument is also suitable for observations of the positions of comets, the components of the easily separated double stars, etc.; and the theoretical studies may include similar topics.

For the practical work at the observatory, the equipment includes, besides the equatorial telescope, an astronomical transit by Troughton & Sims; a meridian telescope and two zenith telescopes by Fauth, one of the latter being adapted to photographic methods; altazimuths by Troughton & Sims, and Fauth; a Howard mean-time clock; chronometers by Negus and Nardin; and surveyor's transits, sextants, chronographs and auxiliary instruments of various kinds.

**Adjustment of Observations.** Observations of a geodetic nature will be considered, or this work may be made to apply to other lines of investigation if desired, such as physics, mechanics, and hydraulics. A general treatment of the method of least squares may be given if desired.

**Terrestrial Magnetism.** A Kew magnetometer, a Barrows dip circle, and a declinometer afford means for investigating the magnetic elements.

**Gravity.** One of the piers of the department, has been occupied as a gravity station by the United States Coast and Geodetic survey, and is therefore connected, through Washington, with the absolute determination made at Potsdam, Germany.

The instrumental equipment for this class of work includes, besides a Kater pendulum, a Mendenhall half-second pendulum apparatus of the pattern used in the United States Coast and Geodetic Survey, the pendulum being swung in a partial vacuum. The literature of this subject is well represented in the library.

**Standards of Length.** For the study and comparison of measures of length, the metric laboratory is provided with a four-meter comparator with micrometer microscopes and carriage movable transversely to accommodate two or more measures simultaneously, an ice-bar apparatus, etc. The comparator is in a case for protection from sudden changes of temperature, and the laboratory temperature is nearly constant. A four-foot comparator is available for the direct study and graduation of leveling rods.

For the investigation of the behavior of apparatus, especially tapes, under field conditions, and also for the standardization of tapes, a 100-meter comparator may be used. The end marks are underground and well isolated from surface disturbance. Micrometer microscopes on the piers above these marks are referred to them by means of special plumbing apparatus, the tapes being observed directly through the microscopes. In this work, 50-meter Invar tapes may be used, whose standardization has been made with precision by the National Bureau of Standards.

The graduation of scales, as well as their study, is facilitated by means of a dividing engine made by the Société Générale. For the most delicate graduation work, the large Rogers dividing engine in the Department of Physics is available.

The laboratory standard of length is a steel meter bar of the international type, by the Société Générale. It has been compared with the international prototype at Washington. A Rogers four-inch and decimeter scale on speculum



metal, accurately compared, and a brass line-and-end-measure yard are also available.

**Investigation of Instruments.** In addition to the special equipments mentioned above, considerable apparatus of an auxiliary character for the investigation of instruments is at hand. Notable pieces are the large Dodge-Mayhew level-trier, a spherometer with special adaptation for the study of pivots, a pair of pier collimators, micrometer microscopes, etc. Also, there are the usual engineering instruments of many types, transits, theodolites, heliotropes, levels, and meteorological instruments. For standards of temperature, there are several precision thermometers by Boudin, Tonnelot, and others, some of which have been standardized by the International Bureau of Paris. A special comparator is available for the calibration of thermometers, and there is a pyrometer for the study of high temperatures.

The work arranged especially for graduate students may be divided into the following courses:

- a. Theory of Least Squares and Adjustment of Observations.
- b. Theoretical Geodesy and Geodetic Methods.
- c. Advanced Geodetic Astronomy.
- d. Geodetic Laboratory and Field Investigations.

The character of the work, as well as the amount of time to be devoted to it, will be arranged with each student. It is usually desirable that the theoretical reading be accompanied by illustrative laboratory practice, and in the more advanced portions of his work the student will generally devote most of his time to special investigations.

The preparation necessary for graduate work in geodesy and astronomy should include, in particular, general courses in physics, chemistry, and mathematics (including differential and integral calculus), as well as the usual undergraduate work in surveying and mechanics. The ability to read German scientific works is almost indispensable.

Elementary Surveying; Advanced Surveying; Topographic, Hydrographic, and Geodetic Survey (Camp); Survey Computations and Mapping.

Least Squares: Adjustment of Observations. Assistant Professor UNDERWOOD.

Advanced Topographic Surveying. Professor BOOTHROYD.

Geodesy and Geodetic Laboratory. Professor BOOTHROYD and Assistant Professor UNDERWOOD.

Geodetic Astronomy. Professor BOOTHROYD.

## APPLIED MECHANICS

Professors: S. G. GEORGE; E. W. RETTGER.

Instructor: E. V. HOWELL.

The facilities of the library in Lincoln Hall, with the added sources available in the University Library, permit extensive advanced work in the field of applied mechanics.

The prerequisite training for graduate work in this department should cover the range in Mathematics, Physics, Materials, Mechanics, and Structural Design required of Cornell graduates in Civil Engineering. Many of the advanced treatises are in French or German, and a reading knowledge of technical works in these languages is extremely valuable.

Mechanics of Engineering. Professor GEORGE, Assistant Professor RETTGER, and Mr. HOWELL.

Advanced Mechanics. Professor GEORGE and Assistant Professor RETTGER.  
Special Courses in Advanced Mechanics for Graduates. Professor GEORGE and Assistant Professor RETTGER.

Engineering Problems. Professor GEORGE and Assistant Professor RETTGER.

### HYDRAULICS AND HYDRAULIC ENGINEERING

Professors: E. W. SCHODER; F. J. SEERY; J. L. WEBER.

**The Hydraulic Laboratory.** The unique location and construction of this laboratory render practicable investigations requiring a steady gravity water supply for long periods using relatively large flows of water. The water supply is obtained from Fall Creek with a watershed of 126 square miles. Beebe Lake, a pond of about 20 acres, has been formed by the construction of a concrete dam, 26 feet high, with a spillway crest length of 130.5 feet. At one end of the dam there is an additional flood spillway 141.5 feet long. A rectangular canal 420 feet long and 16 feet wide is supplied from Beebe Lake through six headgates for controlling the amount of flow. The upper portion of the canal is 17.7 feet deep and the lower portion is 10 feet deep. In this canal are two sharp crested weirs, 16 feet long, over which discharges as large as 400 cubic feet a second may be passed.

A short branch canal 6 feet wide, in the upper portion of the laboratory building, may be supplied directly from Beebe Lake by means of a 48-inch steel pipe line with a short 30-inch branch at its lower end. A 30-inch valve controls the flow from the 48-inch pipe into the 6-foot canal. The 6-foot canal discharges either to waste into the pool below Triphammer Falls (a sheer drop of 60 feet) or into the upper end of a steel stand-pipe 6 feet in diameter and 60 feet high. A suitable mechanism causes an instantaneous diversion of discharges as large as 60 cubic feet a second from the waste flume into the standpipe or vice versa. The 6-foot standpipe is provided at the bottom with a 36-inch discharge valve operated by hydraulic pressure. There is a float gauge indicating accurately the height of the water surface in the standpipe. An independent 10-inch pipe line from Beebe Lake to the bottom of the laboratory supplies the majority of the pieces of apparatus used for class work and research. The 6-foot standpipe may be used also as a supply tank, water being supplied to it either from the 6-foot canal or the 10-inch pipe line.

The lower portion of the large 16-foot canal, 350 feet long between weirs, is used for measurements with floats and current meters. An electrically operated car spans this canal and is used for rating the current meters. Models of dams may be built in the canal and the flow over them investigated with precision. Outside work is usually impracticable between December 1 and April 1.

In the laboratory building there is also a concrete flume 2 feet wide, 4 feet deep, and 25 feet long. Flows up to 11 cubic feet a second can be passed through this and measured volumetrically. This flume is conveniently arranged for experiments on small weirs, low head orifices, etc.

There are numerous flanged connections from 4 to 12 inches diameter for the attachment of apparatus.

The hydraulic machinery equipment at present includes only types of the turbine, Pelton-Doble wheel, multi-stage centrifugal pump and hydraulic ram, all arranged for testing.

Prospective graduate students should bear in mind that only under very rare circumstances can a candidate for the Master's degree, or even the Doctor's degree, hope to carry out an experimental investigation in hydraulics involving large flows of water up to the capacity of the laboratory or involving extensive constructions. The limitations of seasonal availability of water and of weather conditions, as well as of time, labor, and expense, are such that the graduate student in this subject should look forward to investigations of lesser apparent magnitude, but often of equal value.

Hydraulics. Professor SCHODER, and Assistant Professor WEBER.

Hydraulic Measurements. Professor SCHODER.

(This laboratory course is a prerequisite to the other more advanced and specialized work.)

Experimental Hydraulic Motors and Pumps. Professor SCHODER.

Experimental Hydraulic Investigation. Professor SCHODER.

Water Supply. Professor SEERY.

Hydraulic Constructions. Professor SEERY.

Water Power Engineering. Professor SEERY.

Pumps and Pumping. Professor SEERY.

Hydraulic Engineering. Professor SEERY.

General Hydrology. Professor SEERY.

## SANITARY ENGINEERING

Professors: H. N. OGDEN; C. L. WALKER.

The courses offered to graduate students may be divided into two classes; those dealing with the design, construction, and operation of sewage disposal plants and water purification plants; and those fundamental studies in chemistry, biology, and bacteriology, which the undergraduate student in civil engineering may not have been able to pursue.

A sewage-disposal plant in the city of Ithaca offers opportunity for experimental study of septic action and of sedimentation. Within a short distance from Ithaca are five other plants, well adapted for critical examinations of efficiencies. Numerous other opportunities are offered for the study of similar questions.

The laboratories in all the related subjects are open to graduate students in sanitary engineering. The courses in organic chemistry are well adapted to the study of the disposal of trade wastes. The courses in mycology and botany afford excellent opportunity for studying the life history of algae and other water plants which affect both stream pollution and purification. The

courses in bacteriology deal not only with water bacteria and the colon types but also with pathogenic forms interesting from the point of view of epidemiology. The courses in the Medical College enable the student to trace the effect of the pollutions of water supply and to acquire a working knowledge of the water-borne diseases. Finally, a well equipped sanitary laboratory, established in the College gives an opportunity for students to acquire not merely laboratory technique in water analysis, but also a practical training in the forms of interpretation. This laboratory is also available for experimental studies of the efficiency of water and sewage plants and of methods of dealing with the refuse from factories. The library is well provided with the literature of the various subjects bearing on municipal sanitation.

The following courses in other subjects in the University may profitably be taken by graduate students in sanitary engineering: History and Political Science 76a; History and Political Science 54a; Chemistry 30; Chemistry 75; Botany 11; Entomology 19; Medical College, course 43.

In order to take advanced work in this department, the student must have had an equivalent of the preliminary courses listed below.

Sanitary Biology; Municipal Engineering; Purification and Control of Water Supplies; Sewerage Works; Sanitary Laboratory; Sanitary Design.

Municipal Engineering. Professor OGDEN.

Purification of Water. Professor OGDEN.

Special Laboratory Work. Assistant Professor WALKER.

## RAILROAD AND HIGHWAY ENGINEERING

**Professors:** F. A. BARNES; W. L. CONWELL.

**Instructors:** J. E. PERRY; CARL CRANDALL.

The library contains an excellent collection of books, technical periodicals, and publications of engineering societies on railroad and highway construction and maintenance, and on railroad operation. Reports of cities and of state highway commissions and specifications for the construction and maintenance of roads and pavements are also available. Standard plans and other data have been contributed from time to time by railroad companies and others.

Maps and profiles of location surveys, many of them relocations of existing lines, are on file in the office of the department and form an excellent basis for the study and comparison of alternate routes and for economic design. Surveys for structure sites and equipment for gathering additional data are available.

**Highway Laboratories.** The laboratory for testing rock and other non-bituminous highway materials is equipped with a Deval machine, Page impact machine for the toughness test, impact machine for the cementation test, ball mill, core drill, diamond saw, grinding lap, Dorry machine, briquette molding machine, rattler for brick testing, and sieves for examination of aggregates.

The bituminous laboratory is housed in a separate building devoted solely to this purpose and at present is equipped with an Engler viscosimeter, drying ovens, a New York State Board of Health oil tester, balances, a New York Testing Laboratory penetrometer, molds for the float test, etc., a ductility testing machine,



bitumen extractors, equipment for distillations, and sieves for examination of sheet asphalt mixtures and aggregates for bituminous concretes, thus enabling the student to make the standard tests of bituminous materials, and bituminous paving mixtures.

The other laboratories of the College of Civil Engineering for the study of the strength and other properties of materials and the Ceramic Laboratory of the Department of Geology, which is equipped with kilns and a brick machine, are also available for the use of students specializing in this field.

Attention is called to the facilities available in other departments of the University to supplement the work outlined below; as for example, in political science, the course on railroad transportation and, in electrical engineering, courses dealing with the application of electricity to the operation of railroads.

Special courses of investigation and study will be arranged to meet individual needs.

**Railroad Surveying and Engineering Construction.** Prerequisite for graduate work.

**Railroad Maintenance of Way.** Professor BARNES and Mr. PERRY.

**Railroad Operation and Management.** Professor BARNES and Mr. CRANDALL.

**Highway Engineering.** Professor BARNES, Assistant Professor CONWELL, and Mr. PERRY.

(The three preceding courses will not be accepted as part of a major subject unless they are accompanied by special work and reports.)

**Railroad Engineering Design.** Professor BARNES and Mr. CRANDALL.

**Highway Laboratory.** Professor BARNES, Assistant Professor CONWELL, and Mr. PERRY.

**Highway Engineering Design.** Professor BARNES, Assistant Professor CONWELL, and Mr. PERRY.

## BRIDGE ENGINEERING

Professors: H. S. JACOBY; E. N. BURROWS; L. C. URQUHART.

In this subject, instruction is offered in the determination of loading, stresses, and design of roofs, buildings, bridges, arches, foundations, piers, retaining walls, and other structures of timber, steel, reinforced concrete, and masonry.

A collection of over seven thousand blue prints is available, giving detail plans of American railroad and highway bridges, roof trusses, steel buildings, and various structures of reinforced concrete and masonry, and there are also about one thousand selected photographs of all classes of bridges designed in this country.

The twenty-six bound volumes of blue prints used for office reference by the late George S. Morison, which contain the plans of all the bridges designed under his direction as consulting engineer, form a part of the reference library.

The library contains practically all the important books on bridge and structural engineering. It also contains a valuable collection of theses, those on original investigations relating to arch bridges being especially noteworthy. These investigations have been conducted so as to form an extended and closely

related series. Their results constitute an important addition to previous knowledge of the relative strength, stiffness, and weight of different types of construction, and of the method for their investigation and design. Special facilities are available for the study of secondary stresses in bridge trusses.

To qualify for graduate work in bridge engineering, a knowledge of theoretical mechanics, of the strength of materials, and of engineering construction is required in addition to the preliminary course in structural design named below.

Structural Details, Bridge Stresses, and Bridge Design.

Reinforced Concrete Arch. Assistant Professor URQUHART.

Higher Structures. Professor JACOBY, and Assistant Professor BURROWS.

Masonry and Foundations. Professor JACOBY and Assistant Professor URQUHART.

Steel Buildings. Assistant Professor BURROWS.

Concrete Construction. Assistant Professor URQUHART.

Engineering Design. Professor JACOBY and Assistant Professor URQUHART.

## ARCHITECTURE

Professors: F. H. BOSWORTH; C. A. MARTIN; O. M. BRAUNER; A. C. PHELPS; GEORGE YOUNG; CHRISTIAN MIDJO; L. P. BURNHAM; G. R. CHAMBERLAIN; H. S. GUTSELL; ROBERT NORTH; W. K. STONE; H. E. BAXTER.

Graduate work is offered in architectural design; in the history of architecture, painting, and sculpture; in advanced construction; and in drawing, painting, modeling, and decoration.

Candidates for the Master's degree in architecture must have had preliminary training in the subjects elected for graduate work equivalent to that required in like subjects in this University for the degree of Bachelor of Architecture or of Bachelor of Science in Architecture. Architectural Design, History of Architecture, and Architectural Construction are offered as major subjects for the Master's degree; Drawing, Painting, Modeling, Decoration, and approved courses in other departments of the University may be elected as minor subjects.

The facilities for graduate work in architecture are excellent. Large, well-lighted drafting-rooms and studios are provided and a special architectural library—one of the most complete in America—comprising several thousand books, photographs, lantern-slides, and numerous original drawings, is located in White Hall where it is easily accessible to the student.

The standard of work is of a high order and instruction is given by means of lectures, seminary discussions, and especially by direct personal criticism and advice.

The following courses are open to graduate students:

Architectural Design. Professors BOSWORTH, BURNHAM, and NORTH.

History of Architecture. Professor PHELPS.

Construction. Professors MARTIN, YOUNG and BAXTER.

History of Painting and Sculpture. Professors BRAUNER and GUTSELL.

Drawing and Painting. Professors BRAUNER, MIDJO, CHAMBERLAIN, and STONE.

Modeling. Professor MIDJO.

Decoration. Professors MIDJO and NORTH.

## THE MEDICAL SCIENCES

## As Presented in the Medical College in New York City

For a full description of the work in the Medical College at Ithaca and in New York City, see the Announcement of the Medical College.

The Medical College in New York City comprises the main building on First Avenue opposite to Bellevue Hospital and the adjacent Loomis Laboratory on Twenty-sixth Street.

The Main Building occupies the entire block between Twenty-seventh and Twenty-eighth Streets on First Avenue, extending back one hundred feet, thus affording an available space of nearly 20,000 square feet on each of its seven floors.

The Department of Anatomy occupies the entire fifth floor. In addition to a commodious and well lighted dissecting room there are numerous smaller rooms for investigation and research in anatomy, histology, and embryology, preparation rooms, storage rooms, etc.

The fourth floor is devoted entirely to pathology, bacteriology, and the College Library. There are several rooms for investigators and assistants, preparation rooms, class rooms, a teaching museum, and a library containing current numbers and many back files of the important journals devoted to medical sciences, in English, French, and German.

The facilities offered by the departmental libraries in the medical school are readily amplified by use of the various libraries in New York City, several of which are within easy reach of the college buildings. Among these the library of the New York Academy of Medicine, the second largest medical library in the country, is worthy of special mention.

The Departments of Physiology and Chemistry occupy the third floor of the main College building and are equipped with laboratories devoted to the problems of research, in addition to those used by students in the course leading to the M.D. degree. Organic chemistry, physiological chemistry, and chemical pathology are thus especially provided for. One large room is set aside for calorimetry and another has been equipped as an operating room in connection with the work in experimental physiology.

The lower floors of the main building contain the college offices, the dispensary, lecture rooms, class rooms, and a power plant.

The Loomis Laboratory, besides the pharmacological laboratories for medical students, contains laboratories for research on bacteriology, hygiene, physiological chemistry, experimental medicine, and pharmacology. Facilities are thus furnished to graduates who may desire to pursue further study or research in the various departments of laboratory investigation.

The second floor of this laboratory is devoted entirely to pharmacology and its allied sciences; the first and third floors provide accommodations for the Department of Experimental Medicine with research laboratories for physiological chemistry and chemical pathology. The fourth and fifth floors are devoted to research in pathology, bacteriology, hygiene, serology, and immunology; they also provide ample accommodations for photomicrography.

Bellevue Hospital, whose gates open directly opposite the college buildings, furnishes ample opportunity for extending the problems of the laboratory to the bedside, besides offering many intricate problems for solution in the laboratory.

The Hospital is organized in four divisions, one of which has, by the Trustees of the Hospital, been placed at the disposal of the Faculty of the Cornell University Medical College for medical research and instruction. The services thus intrusted to the College include, continuously, ninety medical beds, ninety surgical beds, thirty-two beds devoted to gynecology; twenty-two beds to genito-urinary diseases, and for one-half the year fifty-four obstetrical beds, together with equal privileges with the other three divisions, giving continuous opportunity for instruction and research, in the wards devoted to the treatment of alcoholic diseases, tuberculosis, and the psychopathic diseases.

**New York Hospital.** The Medical College, through the courtesy of the Governors of the New York Hospital, has long been accorded certain privileges for instruction in its wards, but on the first of January, 1913, a definite arrangement was established between Cornell University and the New York Hospital, through the donation to the hospital of a generous fund which was presented by Mr. George F. Baker, one of the Governors of the hospital, upon the condition that hereafter half the entire medical, surgical, and pathological services of the institution shall be definitely assigned to the Cornell University Medical College for the advancement of its teaching and research.

By the most advantageous arrangement the University nominates the visiting staff and laboratory staff of its division and secures the admission of its students to the wards as clinical clerks, which enables the College to make a definite provision in its courses of instruction and research for work in the New York Hospital, and this is now closely correlated in the curriculum with the similar work which has hitherto been done in Bellevue Hospital. Furthermore, the laboratory staffs of the different departments of the Medical College are placed at the service of the Hospital for the purposes of extending its scientific works. The hospital service thus assigned to the College comprises 100 beds. This service is exceedingly active. It includes several thousand acute and emergency cases brought in annually from a large ambulance and dispensary district.

The services thus supplied to the College are ample for advanced research as well as for undergraduate instruction.

**Memorial Hospital.** Through the generosity of the late Dr. James Douglas, who provided the Hospital an endowment for the study and treatment of cancer and allied diseases, the Memorial Hospital became affiliated in 1914 with Cornell University Medical College.

The conditions upon which this union was consummated place upon Cornell University Medical College the responsibility for the medical and surgical activities of the Hospital, subject however, so far as administrative action is concerned, to the approval of its Board of Managers. The Cornell University Medical College is required to approve the five medical members of the Board of Managers of the Memorial Hospital and to nominate their successors in case of vacancies, and to name the medical and surgical staff, subject to the approval of the Board of Managers of the Hospital.

#### **Anatomy**

**Professors:** C. R. STOCKARD; C. V. MORRILL; R. CHAMBERS, JR.

**Instructors:** G. PAPANICOLAOU; L. W. SNEED; J. F. NONIDEZ.

Abundant material and sufficient apparatus are available for advanced study and work in the various branches of anatomy, embryology, histology, com-



parative morphology, descriptive anatomy, and experimental anatomy. Students desiring to pursue graduate work in any of these branches must have had in their college courses preliminary training in general zoology and comparative anatomy. A reading knowledge of German and French is essential.

New York City offers exceptional advantages for obtaining fresh human material. The large slaughter-houses are accessible for comparative mammalian tissues and organs. The extensive collections of specimens and models in the city museums are extremely helpful and instructive to the advanced student.

The members of the staff offer courses in the various phases of anatomy in which they are especially engaged. The courses offered for the medical students appear in the Announcement of the Medical College, and are particularly recommended to those students who have not pursued work of this kind. Technical and practical anatomical work are fully provided.

**Preliminary Requirements:** Physics, Chemistry, and Biology as required for admission to the Medical College.

**Morphology; Embryology; Histological Technic; General Histology; Microscopic Anatomy and Organology; Descriptive Anatomy** including courses in dissection of the human body; Demonstrations on the Cadaver; Live Anatomy; Topographical Anatomy; Neuro-Anatomy and Neuro-Histology; Applied Anatomy; Organs of Special Sense; Anatomical Research.

**Anatomy of the Living Body.** Assistant Professor MORRILL.

**Special and Topographical Studies of Different Regions.** Professors STOCKARD and MORRILL.

**Human Histology and Histogenesis.** Assistant Professor CHAMBERS and Dr. NONDEZ.

**Experimental Morphology.** Professor STOCKARD.

**Anatomy of the Infant and Postnatal Development.** Professor STOCKARD.

### Physiology

**Professor:** GRAHAM LUSK.

**Lecturers:** D. J. EDWARDS, SAMUEL GOLDSCHMIDT.

Students desiring to elect physiology as a major course, in addition to completing the course in general physiology given to medical students, will be required to undertake some special problems, preferably dealing with aspects of nutrition or circulation. Students electing physiology as a minor course may select either the work in general physiology given to medical students or may select only a portion of this course (e. g., nutrition, circulation, etc.) provided an additional amount of special work in these subjects is undertaken.

A preliminary knowledge of chemistry—analytical, organic and physiological, as well as of physics—is requisite for those who select physiology as a major.

**General Physiology.** Comprising Nerve Muscle Physiology, Central Nervous System, Special Senses, Respiration, Circulation, Secretion, Digestion, Metabolism.

**Physiology of Nutrition.** Professor LUSK, Dr. GOLDSCHMIDT.

**Physiology of Circulation.** Dr. EDWARDS.

**Physiological Chemistry and Chemical Pathology**

Professor: S. R. BENEDICT.

Instructors: T. P. NASH; E. OSTERBERG; E. FRANKE.

The laboratories available for advanced work and research in physiological chemistry and chemical pathology include those of the Department of Chemistry, located in the main College building, the chemical laboratories at Bellevue Hospital, and a research laboratory in the General Memorial Hospital. These laboratories provide adequate equipment for investigation in a great variety of special problems in the chemistry of the plant, animal, or human organism in health or disease, by chemical, physical, or optical methods. In the College library the principal journals relating to these subjects are on file.

Students expecting to pursue investigation in physiological chemistry or chemical pathology should have adequate preliminary training in inorganic, analytical and organic chemistry, as well as in physics, physiology, and physical chemistry, though a study of these latter subjects could be pursued at the College, together with more advanced work in special lines.

Organic and Physiological Chemistry; Research.

Physiological Chemistry. Professor BENEDICT.

Chemical Pathology. Professor BENEDICT.

**Pathology and Bacteriology**

Professors: JAMES EWING; W. J. ELSE; O. H. SCHULTZE; J. C. TORREY;  
E. S. L'ESPERANCE.

Instructors: A. F. COCA; G. W. WHEELER; M. C. KAHN; A. H. RAHE.

The laboratories of pathology and bacteriology occupy the fourth floor of the main building and the third and fourth floors of the Loomis Laboratory. The equipment includes all the means commonly employed in pathological research and much new and original apparatus. Both laboratories are provided with suitable quarters for the care of animals. The departmental library includes about 8,000 bound volumes and a large and valuable collection of monographs and reprints. There is an extensive collection of specimens illustrating pathological histology, much material for histological study, and a museum containing about 2,000 specimens. The recent material from the autopsies at several hospitals is constantly available for study, and furnishes a supply of problems in many fields, which is practically inexhaustible. Applicants who have been admitted to the Graduate School are urged to present the degree of Doctor of Medicine for admission to these courses. A limited number of fellowships is available in this department.

Preliminary requirements. Anatomy including Histology and Embryology.

General Pathology; Special Pathology; Pathological Anatomy; Medico-legal Pathology; Autopsy Technics; Experimental Pathology; Bacteriology; Immunology; Hygiene and Preventive Medicine.

General Pathology. Professor EWING.

Special Pathology. Professors EWING and L'ESPERANCE.

Bacteriology. Professor ELSE, Dr. WHEELER, and Mr. RAHE.

Immunology and Serology. Professor ELSE and Dr. COCA.

Preventive Medicine and Hygiene. Professor TORREY.

### Pharmacology

Professors: R. A. HATCHER; C. EGGLESTON.

The laboratory of pharmacology in the Loomis Laboratory is well equipped for general work and research in pharmacology and special opportunities will be afforded for doing work involving the action of drugs on the circulatory system and methods of biological testing of drugs and medicines, either supplementing or replacing chemical tests for activity and identity.

The departmental library is sufficient for the immediate needs of workers and its facilities are readily amplified by the College and other libraries nearby which furnish every opportunity for extending the work.

A preliminary knowledge of Chemistry and Physiology is required.

Materia Medica and Pharmacy; Pharmacology.

Research in the Pharmacodynamics of Drugs. Professor HATCHER and Dr. EGGLESTON.

Toxicology. Professors HATCHER and EGGLESTON.

## FELLOWS AND GRADUATE SCHOLARS

1920-1921

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### UNIVERSITY FELLOWS

**The Cornell Fellowship in English:**

Leah Lazar Lowensohn, A.B. (Cornell) February 1921.

**The McGraw Fellowship in Civil Engineering:**

Nee Sun Koo, B.S.C.E. (Gov't Institute of Technology) 1918; M.C.E. (Cornell) 1919.

**The Sage Fellowship in Chemistry:**

Frank Howell Pollard, B.Chem. (Cornell) 1916.

**The Schuyler Fellowship in Entomology:**

William Harold Brittain, B.S.A. (McGill University) 1911.

**The Sibley Fellowship in Mechanical Engineering:**

Archer Olin Leech, B.S. (Oregon State College) 1918.

**The Goldwin Smith Fellowship in Botany:**

Robert Morris Volkert, B.S. (Cornell) 1920.

**The President White Fellowship in Physics:**

Ruth Agnes Yeaton, B.A. (Mt. Holyoke) 1913.

**The Erastus Brooks Fellowship in Mathematics:**

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**The University Fellowship in Architecture:**

Kenneth Carver, B.Arch. (Cornell) 1920.

**The University Fellowship in Romance Languages:**

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**The University Fellowship in German:**

Cornelia P. H. Zeller, A.B. (Cornell) 1916.

**The University Fellowship in Agriculture:**

Thomas Kennerly Wolfe, B.S. (Virginia Polytechnic Institute) 1914; M.S. (same) 1915.

**The Charles Bull Earle Memorial Fellowship in Mechanical and Electrical Engineering:**

Vartkes Migrdichian, A.B. (Cornell) 1919.

**The President White Fellowships in Modern History:**

Ernest William Nelson, A.B. (Clark) 1916; A.M. (Clark) 1920.

**The President White Fellowship in Political and Social Science:**

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**The Susan Linn Sage Fellowships in Philosophy:**

Eve Tenney Knower, B.A. (University of Wisconsin) 1918; A.M. (same) 1919.  
Joseph Harry Griffiths, B.A. (Lawrence College) 1918; A.M. (Northwestern) 1920.

**The Susan Linn Sage Fellowship in Psychology:**

(Divided into 2 Graduate Scholarships for the academic year of 1920-1921).  
(See Scholarships).

**The Fellowships in Political Economy:**

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Chu Hsiao, A.B. (University of Missouri) 1920.

**The Fellowships in Greek and Latin:**

Marion Elizabeth Blake, B.A. (Mt. Holyoke) 1913; A.M. (Cornell) 1916.  
Helen Margaret Corner, A.B. (Indiana State Normal) 1911; A.M. (Indiana University) 1912.

**The Fellowship in American History:**

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**The Edgar J. Meyer Memorial Fellowship in Engineering Research:**

Frias P. Esquivel, B.S.C.E. (University of Philippines) '19.

**SPECIAL FELLOWSHIPS****The Du Pont Fellowship in Chemistry:**

Arthur Walker Bull, B.Chem. (Cornell) 1919.

**The Grasselli Fellowship in Chemistry:**

Emil Kline, A.B. (Cornell) 1920.

**The Chautauqua County Tomato Improvement Fellowship:**

Ridgely Wilson Axt, B.S. (Maryland State) 1920.

**The Eden Valley Fellowship:**

L. O. Gratz, A.B. (Bluffton) 1915.

**The Hampton Potato Grower's Fellowship:**

O. C. Boyd, B.S. Agr. (Oklahoma A. and M.) 1916.

**The Herman Frasch Fellowships:**

F. P. Schlatter, B.S. (Pennsylvania State College) 1915.  
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**The North Fork Fellowship:**

I. H. Vogel, B.S. (Iowa State College) 1916; M.S. (same) 1917.

**The Steuben County Seed Improvement Fellowship:**

K. H. Fernow, B.S. (Cornell) 1916.

**The Williamson Vegetable Laboratory Association Fellowship:**

A. G. Newhall, B.S. (University of Minnesota) 1918.

**The Wilson Growers' Fellowship:**

R. P. White, B.S. (Dartmouth) 1918.

**GRADUATE SCHOLARS****The Susan Linn Sage Graduate Scholarships in Philosophy:**

1. Marjorie Silliman Harris, B.A. (Mt. Holyoke) 1913.
2. Harold Robert Smart, B.S. (Wesleyan University) 1915.
3. Henry Richey Smith, A.B. (Ohio Wesleyan University) 1907.
4. Irl Goldwin Whitchurch, A.B. (Northwestern) 1916; A.M. (same) 1917.
5. Margaret R. Nysewander, A.B. (Indiana) 1920.

**The Susan Linn Sage Graduate Scholarship in Psychology:**

Catherine Braddock, A.B. (Victoria University) 1916; A.M. (same) 1917.

**The Graduate Scholarship in Chemistry:**

Josephine Souders, A.B. (Cornell) 1916.

**The Graduate Scholarship in Mathematics:**

Frances Almira Atwater, A.B. (Vassar) 1916.

**The Graduate Scholarship in Physics:**

Kuo Feng Sun, B.S. (Pekin Gov't University) 1916; A.M. (Cornell) 1919

**The Graduate Scholarship in Civil Engineering:**

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**The Graduate Scholarship in Latin and Greek:**

Homer Franklin Rebert, A.B. (Franklin and Marshall) 1912; A.M. (same) 1919.

**The Graduate Scholarship in Archaeology and Comparative Philology:**

Cora Rolfe Laubscher, B.A. (Randolph-Macon) 1915.

**The Graduate Scholarship in Vertebrate Zoology:**

Herbert Freidman, B.S. (College of the City of N. Y.) 1920.

**The Graduate Scholarship in English:**

Albert Walker Liddle, A.B. (Cornell) 1920.

**The Graduate Scholarships in Psychology (1920-1921):**

Anna K. Whitchurch, A.B. (Lawrence) 1916, A.M. (Northwestern) 1917.  
Grace K. Adams, A.B. (Randolph-Macon) 1920.

**The Graduate Scholarship in History:**

Gussie Gaskill, A.B. (Kansas) 1918; A.M. (same) 1919.

## ADVANCED DEGREES

1919-1920

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### MASTERS OF ARTS

Conferred October 1, 1919

- Gladys Katherine Bleiman, A.B.: Philosophy; Ethics. Thesis: *The development of the idea of reason in Greek philosophy.*
- David Clark Cabeen, A.B.: French; Spanish. Thesis: *The literary criticism of M. Anatole France.*
- Christianna Smith, A.B.: Histology and Embryology; Pathology; Bacteriology. Thesis: *A study of the lipoid content of the kidney of the cat.*
- Jay R. Traver, A.B.: Insect Ecology; Aquiculture. Thesis: *The life history of the black-nosed dace (rhinichthys atronasmus).*

Conferred February 11, 1920

- Alfred Edwards Emerson, B.S.: Biology; Systematic Entomology. Thesis: *The termites of Karlabo Point, British Guiana, and their biology.*
- Mitchell Stokes Lurio, A.B.: Applied Mathematics; Pure Mathematics. Thesis: *Elastic cylinders subject to torsion.*
- Herbert Saphir, A.B.: Geometry; Mathematical Analysis. Thesis: *Commutative involutory transformations.*

Conferred June 23, 1920

- Che Kwei Chen, A.B.: Statistics; Economics and Finance. Thesis: *The development of vital statistics in England and Wales.*
- Helen Genevieve Corwin, B.A.: Zoology; Botany. Thesis: *A study of the Cornell University collection of lizards from the southwestern United States.*
- Florence Mary Dill, A.B.: English Literature; English Language. Thesis: *The poetical structure of Milton's Paradise Lost.*
- Guy Carleton Bayley Dolson, A.B.: English Literature; English Language. Thesis: *The Consolation of Philosophy of Boethius in English Literature.*
- Louis Gottschalk, A.B.: Modern European History; Ancient History. Thesis: *The development of the republican idea in Jean Paul Marat.*
- Geraldine Mary Magdalene Helfter, A.B.: Literary Criticism: Old English. Thesis: *Sievers on the melody of speech.*
- Barnet Nover, A.B.: Modern European History; American History. Thesis: *Saint-Just and the French Revolution, 1767-1793.*
- Katharine Thorp, A.B.: English Literature; English Language. Thesis: *A pleasant comedy called Wily Beguiled.*
- Shih Tung, A.B.: Psychology; Education. Thesis: *The psychological integration of cold and pressure.*
- Louis Alexander Turner, A.B.: Physics; Organic Chemistry. Thesis: *An X-ray investigation of the dehydration of copper sulphate crystals.*

Milton Christian John Westphal, A.B.: Semitic Languages and Literatures; Philosophy. Thesis: *The God-conception in early Hebrew literature.*

Ruth Agnes Yeaton, A.B.: Physics; Chemistry. Thesis: *The effect of the age and the concentration of a solution upon the photo-electric current developed.*

### MASTERS OF SCIENCE

Conferred October 1, 1919

Sara Bache-Wiig, A.B.: Pomology; Plant Pathology. Thesis: *The graftage of fruit trees.*

Edward Adolf Schmoker, D.V.M.: Obstetrics; Bacteriology. Thesis: *The cervix of cattle in health and disease.*

Conferred February 11, 1920

Livingston Blauvelt, A.B.: Poultry Husbandry; Animal Husbandry. Thesis: *Some factors affecting humidity in pens of the domestic fowl.*

Conferred June 23, 1920

Howard Bushnell Allen, B.S.: Rural Education; Farm Management. Thesis: *Teaching of farm record-keeping in vocational agriculture.*

Paul Andrew Downs, B.S.: Dairy Industry; Agricultural Chemistry. Thesis: *The bacterial flora of powdered milk.*

Francisco M. Fronda, B.Agr.: Poultry Husbandry; Animal Husbandry. Thesis: *A study of the effects of various rations fed to breeding hens.*

Herbert Lester Gilman, D.V.M.: Veterinary Bacteriology and Pathology; Veterinary Obstetrics. Thesis: *The histology and pathology of the oviduct of the cow.*

Chi-ting Kwei, B.A.: Experimental Physics; Theoretical Physics. Thesis: *Detection of short electric waves.*

Giovanni Martinaglia, V.S., B.V.Sc.: Veterinary Bacteriology; Pathology. Thesis: *The direct isolation and cultivation of human, bovine, and avian tubercle bacilli.*

Merl Perrott Moon, A.B.: Dairy Industry; Organic Chemistry. Thesis: *Methods of grading milk at a city milk plant.*

William Marion Pierce, A.B.: Experimental Physics; Theoretical Physics. Thesis: *Electrolytic capacity of platinum electrodes in an alcoholic solution of rhodamine B.*

Marian Randolph Priestley, B.S.: Animal Husbandry; Veterinary Physiology. Thesis: *The vitamine efficiency of raw and boiled milk.*

Moacyr Alves de Souza, Medico-Veterinario: Veterinary Pathology; Veterinary Bacteriology. Thesis: *A study of fatty degeneration in the parenchymatous organs of domestic animals.*



**MASTERS OF SCIENCE IN AGRICULTURE****Conferred October 1, 1919**

Charles Burt Gentry, A.B., B.S. in Ed.: Rural Education; Farm Management.  
Thesis: *Teaching vocational agriculture in the high school through the use of the survey.*

Lloyd Wesley Steelman, B.S.: Poultry Husbandry; Political Economy. Thesis:  
*How cold storage affects the price of fresh eggs.*

**Conferred February 11, 1920**

Ward Charles Jensen, B.S.: Farm Crops; Botany. Thesis: *A survey of the bean production in western New York.*

Gordon Kennedy Middleton, B.S.: Farm Crops; Plant Physiology. Thesis:  
*The principles of intertillage.*

**Conferred June 23, 1920**

Vigfus Asmundson, B.S.A.: Poultry Husbandry; Plant Breeding. Thesis:  
*The relation of the keel bone to egg production.*

William Harold Brittain, B.S.A.: Economic Entomology; Systematic Entomology. Thesis: *The green apple bug—lygus communis var. novascotiensis Knight.*

Lewis Arthur Eyster, A.B.: Plant Breeding; Systematic Botany. Thesis:  
*A case of reduced vigor in a cross between two varieties of linum usitatissimum L.*

John Lewis Earl McCord, B.S.: Farm Management; Animal Husbandry.  
Thesis: *Some results from a farm management survey of thirty-seven farms in Jefferson County, Pennsylvania.*

Louis Harold Schwarte, B.S. in Agr.: Animal Husbandry; Dairy Industry.  
Thesis: *The factors affecting the market price of beef cattle for the ten-year period 1910-1920.*

Gates Sterling Vickers, B.S.: Poultry Husbandry; Rural Education. Thesis:  
*A study of some factors affecting egg production.*

William Jack Weaver, B.S.: Rural Education; Farm Management. Thesis:  
*A study of conditions in Livingston County, New York, affecting the establishment of departments of vocational agriculture.*

**MASTERS IN LANDSCAPE DESIGN****Conferred October 1, 1919**

Joseph Pullman Porter, B.S.: Landscape Design; Plant Materials. Thesis:  
*Landscape Architecture: Its relation and application to the country and village schools of New York State.*

**Conferred June 23, 1920**

Norman Newton, B.S.: Landscape Design; Planting Design. Thesis: *Wood-lawn, a residential property near Ithaca, New York.*

## MASTERS IN FORESTRY

Conferred June 23, 1920

- Perkins Coville, B.S.: Silviculture; Forest Protection. Thesis: *Silvicultural problems in the management of forests of the Adirondack hardwood type.*
- John Samuel Everitt, B.S.: Forest Management; Forest Protection. Thesis: *Working plan for a communal forest for the city of Ithaca, New York.*
- Samuel Chadwick Sweeny, B.S.: Silviculture; Forest Management. Thesis: *Forest planting reconnaissance and survey.*

## MASTERS OF CIVIL ENGINEERING

Conferred October 1, 1919

- Chia Yuen Hou, A.T.E.C.: Bridge Engineering; Railroad Engineering. Thesis: *A study of the development of the cantilever and the steel-hinged arch bridge.*
- Hoong Kwie Yen, B.C.E.: Railroad and Highway Engineering; Sanitary Engineering. Thesis: *A study of the economics of railway location.*
- Nai Zung Zee, B.S. in C.E.: Hydraulic Engineering; Railroad Engineering. Thesis: *A study of methods of flood relief.*

Conferred February 11, 1920

- Shih Ta Hsu, B.S. in C.E.: Hydraulic Engineering; Sanitary Engineering. Thesis: *A study of methods of flood control with special reference to the use of reservoirs.*
- Ching Hsien Wang, C.E.: Bridge Engineering; Hydraulic Engineering. Thesis: *A study of the design and construction of swing highway bridges.*
- Percy Suydam Wilson, C.E.: Hydraulic Engineering; Mechanics. Thesis: *An experimental study of the venturi meter principle applied to open channels.*
- Chilton Austin Wright, C.E.: Experimental Hydraulics; Hydraulic Engineering. Thesis: *An experimental study of the venturi meter principle applied to open channels.*

Conferred June 23, 1920

- Douglas Stewart Ellis, A.B., B.Sc., M.A.: Hydraulics; Concrete Construction. Thesis: *The regulation of the outflow of Lake Ontario.*
- Henry Robertson Lordly, C.E.: Experimental Engineering; Concrete Construction. Thesis: *Experiments with piles in clay.*
- I. Hsiang Pei, A.T.E.C.: Railroad and Highway Engineering; Sanitary Engineering. Thesis: *Design of a subway system for Shanghai, China.*
- Zung Kun Ting, B.S.C.E.: Railroad Engineering; Hydraulic Engineering. Thesis: *A study of the development and economy of railway construction in the United States.*
- Chia Tsun Yeh, B.Sc.C.E.: Highway Engineering; Landscape Art. Thesis: *A proposal for the development of the Chinese national highway system.*

## MASTERS OF MECHANICAL ENGINEERING

Conferred February 11, 1920

Liang Hua Shen, M.E.: Electrical Machinery; Power-Plant Design. Thesis: *Leakage flux of polyphase induction machines.*

Conferred June 23, 1920

Tuh Siu Huang, B.Sc. in E.E.: Electrical Engineering; Mathematics. Thesis: *The electrification of the Raton grade of the Atchison, Topeka, and Santa Fé Railroad.*

Wei-Yoh Wu, B.S. in E.E.: Electrical Engineering; Physics. Thesis: *The unification of electrical power supply in the Pittsburgh district.*

## DOCTORS OF PHILOSOPHY

Conferred October 1, 1919

Frank App, B.S.: Farm Management; Plant Physiology; Farm Crops. Thesis: *Farm profits and factors influencing farm profits on 370 potato farms in Monmouth, New Jersey.*

Jesse Franklin Bradley, A.B.: Elizabethan Literature; English Language; Philosophy. Thesis: *The Jonson Allusion Book: A collection of allusions to Ben Jonson from 1597 to 1700.*

Frank William Douglas, A.B., A.M.: Inorganic Chemistry; Analytical Chemistry; Sanitary Chemistry. Thesis: *The chemistry of germanium.*

Daniel Scott Fox, B.S.: Farm Crops; Farm Management; Cost Accounting. Thesis: *An analysis of the cost of growing potatoes.*

Walter Norton Hess, A.B., A.M.: Insect Morphology; Economic Entomology; Zoology. Thesis: *Studies on the lampyridae.*

Clarence Hamilton Kennedy, A.B., A.M.: Insect Morphology; Systematic Entomology; Vertebrate Zoology. Thesis: *A study of the phylogeny of the zygoptera.*

George Merritt Robison, A.B., A.M.: Mathematical Analysis; Geometry; Physics. Thesis: *Divergent double sequences and series.*

Hubert Sheppard, A.B., A.M.: Psychology; Anatomy; Mathematics. Thesis: *Foveal adaptation to color.*

Fred Waldorf Stewart, A.B.: Histology and Embryology; Physiology; Zoology. Thesis: *The development of the cranial sympathetic ganglia in the rat.*

Roy Glen Wiggans, B.S., M.S. in Agr.: Farm Crops; Plant Breeding; Plant Physiology. Thesis: *A classification of the cultivated varieties of barley.*

Ralph W. G. Wyckoff, B.S.: Inorganic Chemistry; Physical Chemistry; Analytical Chemistry. Thesis: *The crystal structures of caesium dichloroiodide and of sodium nitrate.*

Benjamin Percy Young, B.S., M.S.: Insect Morphology; Ecology; Zoology. Thesis: *The attachment of the abdomen to the thorax among diptera.*

## Conferred February 11, 1920

- Murray Wright Bundy, A.B., A.M.: Literary Criticism; Elizabethan Literature; Philosophy. Thesis: *'Fancy' and 'imagination' in classical and mediaeval thought.*
- James Thomas Cusick, B.S.: Agricultural Chemistry; Dairy Bacteriology; Sanitary Chemistry. Thesis: *Phosphorus in butter.*
- Harry Wilmer Dye, B.S., M.S. in Agr.: Plant Pathology; Plant Breeding; Plant Physiology. Thesis: *Two diseases of western New York lettuce: the bottom-rot and the stunt.*
- William Henry Eyster, A.B., A.M.: Plant Breeding; Plant Histology; Systematic Botany. Thesis: *The linkage relations of the factors for tunicate ear and starchy-sugary endosperm in maize.*
- Louis Benjamin Hoisington, B.A.: Psychology; Educational Psychology; Mathematics. Thesis: *On the non-visual perception of the length of lifted rods.*
- Gordon Peter McRostie, B.S.A., M.S. in Agr.: Plant Breeding; Plant Pathology; Soil Technology. Thesis: *Inheritance of disease resistance in the common bean.*
- Cheves West Perky, B.S.: Psychology; Philosophy; Physiology. Thesis: *An experimental study of the imagination.*
- Michael Jacob Zigler, A.B., A.M.: Psychology; Education; Physiology. Thesis: *An experimental study of visual form.*

## Conferred June 23, 1920

- Oliver Morley Ainsworth, B.S.: English Literature; Old English; Greek. Thesis: *Milton's Tractate of Education. Edited with an introduction and notes.*
- Ernest Gustaf Anderson, B.Sc.A.: Plant Breeding; Plant Histology; Organic Chemistry. Thesis: *The inheritance of salmon silk color in maize.*
- Roy David Anthony, B.S., M.S. in Agr.: Plant Breeding; Pomology; Plant Physiology. Thesis: *Asexual inheritance in the violet.*
- Gerhard Baerg, A.B., A.M.: German; Education; French. Thesis: *The supernatural in the modern German drama.*
- Austin Bailey, A.B.: Experimental Physics; Theoretical Physics; Physical Chemistry. Thesis: *A study of the effect of adsorbed gas on the high frequency resistance of copper wire.*
- Homer Guy Bishop, B.S., M.S.: Experimental Psychology; Physiology; Educational Psychology. Thesis: *An experimental investigation of the positive after-image in audition.*
- Claire Comstock, A.B., A.M.: Experimental Psychology; Education; French. Thesis: *An experimental study of meaning and imagery.*
- Lyda May Degener, A.B., A.M.: Comparative Anatomy and Morphology; Human Physiology; Botany. Thesis: *The development of dentary bone and teeth in the lower jaw of *Amia calva*.*
- Forrest Lee Dimmick, A.B.: Psychology; Educational Psychology; Physiology. Thesis: *Visual movement and the phi phenomenon.*
- Vining Campbell Dunlap, A.B., A.M.: Botany (Mycology); Botany (Ecology); Systematic Zoology. Thesis: *Studies of development in the genus *Pleurotus*.*



- Laura Florence, B.Sc., B.A., M.A.: Insect Morphology; Insect Ecology; Pathology and Bacteriology. Thesis: *The hog louse, haematopinus suis, linné: Its biology, anatomy, and histology.*
- Florence Merritt Foster, A.B.: English; Greek Philosophy; Logic and Metaphysics. Thesis: *Materials for a study of Wordsworth's theory of fine art.*
- John William Hebel, A.B., A.M.: Elizabethan Drama; English Poetry; Philosophy. Thesis: *The plays of William Heminges.*
- Robert Thomas Holland, B.D., A.M.: Psychology; Education; Physiology. Thesis: *The after-image of pressure.*
- Major Edward Holmes, A.B., A.M.: Inorganic Chemistry; Physical Chemistry; Economic Geology. Thesis: *Contributions to the chemistry of the hydronitrogens and pernitrides.*
- Edwin Fraser Hopkins, B.S.: Plant Pathology; Plant Physiology; Physical Chemistry. Thesis: *The botrytis blight of tulips.*
- Marguerite Witmer Kehr, B.A., M.A.: Education; Philosophy; Psychology. Thesis: *A comparative study of the curricula for men and women in colleges and universities of the United States.*
- John Frederick Klein, A.B., A.M.: German Literature; Germanic Philology; French Literature. Thesis: *Beirläge zu Paul Heyeses novellentechnik.*
- Harry E. Knowlton, B.S.: Plant Physiology; Physical Chemistry; Pomology. Thesis: *Studies in pollen with special reference to longevity.*
- Abbie Findlay Potts, A.B., A.M.: English Literature; Old English; Greek. Thesis: *The ecclesiastical sonnets of William Wordsworth. A critical edition.*
- George Elmore Reaman, B.A., M.A.: Education; Rural Education; Rural Economy. Thesis: *A method of teaching English to foreigners.*
- Harvey Elmer Stork, A.B., A.M.: Botany (Mycology); Botany (Morphology and Embryology); Vertebrate Embryology. Thesis: *Biology, morphology, and cytoplasmic structure of aleurodiscus.*
- Alice Helen Sullivan, A.B., A.M.: Psychology; Education; Physiology. Thesis: *An experimental study of kinaesthetic imagery.*
- Frank Burkett Wann, A.B.: Botany; Plant Cytology; Biochemistry. Thesis: *The fixation of free nitrogen by green plants.*
- Walter Housley Wellhouse, A.B., A.M.: Economic Entomology; Entomology; Zoology. Thesis: *The insect fauna of the genus Crataegus.*





